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HOME FRUIT GROWING  
IN CALIFORNIA

W. L. HOWARD

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B. H. Crocheron, Director, California Agricultural Extension Service.

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# HOME FRUIT GROWING IN CALIFORNIA

W. L. HOWARD<sup>1</sup>

## INTRODUCTION

THIS CIRCULAR is designed for those who wish to grow fruit and nuts on a small scale for their own use and not for those who may grow fruit as a business. Although nearly all the fruits that the amateur can hope to produce are already available in our home markets, many of us desire to raise something of our own. As a matter of economics, home fruit growing is a poor investment; but happily, no matter how much we may try to convince ourselves to the contrary, we grow home fruits not for monetary gain but as a labor of love. There is a pride of possession in producing some nice fruit, for it can be done; but the work is primarily a sport or recreation.

It is the creative instinct that makes us want to dig in the soil and plant something. The fructifying soil holds great mystery for us all. As most people know, growing things out of the earth is a gamble, where skill and chance combine to make a most fascinating game. If we persist until we acquire skill and wisdom; study our plants, treat them properly, protect them from their enemies, we may be rewarded with all the fruit we can use and (best of all) with some to present to our friends, which is the sweetest of all rewards for the amateur.

As already mentioned, this publication is intended to help the beginner. Whereas practically all of our books and experiment-station publications on the subject were written for commercial fruit growers, this circular is frankly for the amateur, and all the discussions will be from his standpoint. The professional orchardist is always cautioned, for example, to select a site having the climate, soil, water, and marketing facilities that will promote his financial success. The homeowner, on the other hand, must use the site he has, whether all conditions are favorable or not. His back yard may be only a second or a third-rate location for fruit, but he wants to use it. Fortunately, practices unjustifiable on a large scale may be followed in a small way: Poor soil can be greatly modified and ameliorated if one will go to the necessary trouble and expense. To provide for a few trees only, a swampy spot may be reclaimed, an unfavorable soil or subsoil completely made over. Individual fruits or even whole clusters may be protected against diseases and insects by enclosing them in bags made of paper, gauze, or cellophane. Even the mean temperature for a few trees may be raised considerably in a cold,

<sup>1</sup> Professor of Pomology and Pomologist in the Experiment Station.

foggy, maritime climate by flattening them against a south wall—a common practice in England, where peaches otherwise would not ripen out of doors.

Woody plants, including both trees and shrubs, are either deciduous (shedding their leaves in the fall or early winter and remaining dormant till spring), or evergreen (retaining their leaves all year). These convenient terms will be used often in the pages that follow. Although most subtropical fruits are evergreens, evergreen and subtropical are not necessarily synonymous. Both kinds, however, are usually tender. Deciduous fruits, on the other hand, range in hardiness to cold all the way from crab apples and the Sierra plum, which resist sub-zero temperatures, to the fig, which is as tender as the evergreen olive. The great range in climate and the large number of species produced in the different parts of the state make fruit growing in California especially intriguing to the amateur.

#### LIMITATIONS OF FRUIT GROWING

*Climate.*—We think of cold and perhaps of extreme heat as natural and positive delimiters of fruit growing. True; but fruits vary greatly in their ability to withstand temperature extremes. Apples, the wild Sierra plum (*Prunus subcordata*), gooseberries, currants, blackberries, raspberries, strawberries, and eastern grapes may be grown at altitudes of 5,000 and even 6,000 feet in protected locations; but spring frosts may often catch them when in bloom. Lower—up to 4,000 feet—they are reasonably safe; and at this level the eastern sour cherries and Wild Goose type of plum might be added to the list. At 2,000 to 3,000 feet we may include pears, the so-called “blue,” or European, plums (*Prunus domestica*), sweet cherries, quinces, chestnuts, walnuts, and even peaches in protected locations. Below 2,000 feet one may safely grow all the other deciduous fruits such as peach, apricot, Japanese persimmon, pecan, almond, and the more tender blackberry-raspberry-dewberry hybrids like the Logan, Himalaya, Young, and Boysen berries.

Citrus and subtropical fruits can stand but little freezing weather; and some, like the avocado, lemon, and lime, but very slight frost. One may, however, grow tender trees such as the orange and lemon in borderline locations by protecting them somewhat against freezing weather with a 2- or 3-inch covering of cornstalks or tule reeds. The latter, a variety of marsh bulrush, is especially good for the purpose, being pliable and easily worked. They are bound to the trunk at the ground, then drawn up over the tree to enclose all the branches, and finally gathered together at the top and tied. Extra reeds may be needed to

cover thin places. This protection is needed particularly by trees during the first two or three years of their life or until they are well established. Lemon trees may receive some protection if planted a few feet from the south side of a residence or other building large enough to absorb sufficient solar heat during the day to ward off frost at night.

From Monterey Bay northward, oranges, lemons, peaches, and Japanese plums directly exposed to the ocean will not bloom properly or ripen their fruit because the mean temperature is kept too low by cold winds and foggy days. The coastal influence may extend many miles inland, particularly up valleys that open directly upon the ocean.

In the south, between Santa Barbara and San Diego, is a region where latitude, topography, and ocean influences combine to produce a climate mild enough for subtropical plants and yet invigorating enough for deciduous fruits. This large area contains the famous citrus and walnut district, together with spots of varying size where the tenderest fruits, like the lemon and avocado, are at home and others where even the peach, pear, and apple can be grown. Here the great danger is that the deciduous trees will not be chilled enough in winter to break the rest period, a difficulty that causes "delayed foliation" in spring.

California has almost all the climatic conditions to be found in the rest of the United States, with some that do not occur in any other state. We have high mountain valleys where only hardy northern fruits can be grown, hot valleys and lowlands where even the date palm will thrive. We do not, however, have tropical conditions: although there are frost-free sites, the mean temperature is usually too low and the air too dry for tropical plants to flourish.

In the Imperial and Coachella valleys of Imperial and Riverside counties, in the southern part of the state, are large areas where the mean temperature is too high for some deciduous fruits. Nearly all of them can, however, be grown for a few years at least; and some do fairly well, although citrus would be more promising.

Finally, even where frosts and light freezes in winter occur regularly or where minimum temperatures are too low for proper growth, there may be warm spots or thermal zones that nullify the expected influence of latitude and to some extent that of altitude. Notable examples are found at Porterville and elsewhere in Tulare County, Oroville in Butte, Mission San Jose in Alameda, and Esparto in Yolo County. Smaller or more local warm spots are found at many other places from Red Bluff to Bakersfield in the interior valley and likewise along the coast and in the south.

For all practical purposes, then, deciduous trees (those that shed

their leaves in autumn) can be grown in a small way in California wherever dry land occurs, except in the high mountains, where the trees or fruit buds might be killed in winter or the blossoms continuously destroyed by spring frost. Nowhere in the state is the summer temperature too high for growing at least some of the deciduous fruits on a small scale. Winter temperatures, however, may be too mild; and two or three winters in succession without frost or near frost will make the trees sicken and die.

The evergreen or subtropical trees have a much more limited climatic range in California than do the deciduous trees. In general they are restricted to the warmer regions or to almost frost-free locations. Frost is not, however, the only delimiter. A coastal region without frost may still be unsuitable for subtropical fruits because of cold winds, low mean temperature, and frequent summer fogs; most of these fruits demand continuous warmth and long periods of sunshine.

*Soil.*—Wherever a home is likely to be built, the soil is probably not so poor or unfavorable otherwise that it cannot be put into condition to grow a few fruits. A too wet soil can often be improved by draining and a too alkaline one by leaching out the salts or by draining and then leaching. Impervious layers called hardpan, at or near the surface, may be broken up and mixed with coarse sand and humus, or dug out entirely and replaced with good soil. Even if the substratum consists of solid rock, fruit trees can still be grown provided there is an overlying layer of soil 18 inches deep. Stony soil is no deterrent if there is a free admixture of soil. Poor soils may be manured and made fertile; harsh compact soils may be made friable by the generous use of sand and composted leaves or of stable manure.

*Preferred Sites and Soils.*—If a choice of site and soil is possible, as with those who have considerable land in connection with their homes, by all means seek good natural air and water drainage such as would be afforded by a gentle slope. Air drainage is very important at high altitudes or in other places where there is danger of late spring frost. Cold air sinks to the ground at night, but will flow away like water and settle in the low places. A difference of 2 or 3 degrees in night temperatures may determine whether the blossoms are killed or not killed.

The best soil for fruits is one that is medium-textured, like a deep, sandy loam. Such soil would not permit free water to stand on the surface nor underground about the tree roots. Coarse soils such as sands do not hold much water and ordinarily must be irrigated more often than fine-textured soils. If the drainage is poor, a waterlogged condition may result. This would be fatal, for instance, to cherries, peaches,

oranges, and avocados, which cannot stand "wet feet." Although pears, plums, quinces, and apples are more tolerant, wet soils are bad for fruit trees of any kind.

Most home owners have little or no choice of site or soil. Any fruit trees grown must be planted in the restricted area of the yard or kitchen garden. There may have been heavy grading. If there is a fresh fill, it had best be allowed to settle for a year. In all cases, before planting be sure that water does not stand on the surface for more than an hour or two even after a hard rain. Wet soil may be underdrained by laying 3-inch drainage tiling at a depth of 3 or 4 feet or deeper, if an outlet can be provided. Where tile drainage is not possible, dig holes even as large as 6 or 8 feet in diameter and 6 feet deep; then bore still deeper holes in the bottom of the pit and fill them with the coarsest sand obtainable. Finally dump a wagon load of coarse gravel in the pit, and finish filling it up with good top soil. Be sure that the soil is thoroughly settled before planting. If underlaid with a layer of hardpan at a shallow depth, it should be broken up by blasting or dug out and mixed with considerable sand, gravel, and compost so that it will not become recemented. For soil known to be poor the best fertilizer would be large quantities of stable manure plowed or spaded under. Also, well-rotted manure should be used around the newly planted trees and even in the bottom of the holes at the time of planting.

Adobe soils, although usually fertile, are so crusty when dry and so sticky when wet that they are difficult to handle. They may be greatly improved by the addition of coarse sand and of any vegetable mold such as decayed leaves or well-rotted barnyard manure. An insufficient quantity of sand alone, particularly if too fine, would probably do more harm than good. If alkali is the problem, the first step is to determine how much of the salt is present. Pears, figs, and olives will tolerate considerable alkali, but most fruits are definitely intolerant. If permanent drainage can be provided to a depth of 6 feet or more, alkali can be washed out by heavy waterings over a period of several months. For black alkali a heavy application of common sulfur at the rate of 5 to 10 pounds per 100 square feet will be helpful. Peaches and plums may be grown in a moderately alkaline soil by budding or grafting them on the Chinese wild peach (*Prunus Davidiana*).

A soil can be made too fertile with animal manures or with highly nitrogenous mineral fertilizers like nitrate of soda or sulfate of ammonia. Too much wood growth is then apt to be made at the expense of fruitfulness. Trees planted on the site of an old corral or feed-lot are usually undersized and look unhealthy. While no specific remedy is

known for this condition, known as "corral injury," it sometimes yields to the treatment given for little-leaf, namely, to drive zinc glazing tacks into the branches at the rate of two to the inch.

Although most of the soils in the northern half of the state are naturally fertile enough for fruit trees, certain areas in the south and elsewhere that have been clean-cultivated and intensively cropped for years would benefit by an annual application of plant food. From  $\frac{1}{2}$  to 1 pound of ammonium sulfate per 100 square feet of land should meet all requirements.

#### WHAT TO PLANT

The kind of fruits to plant depends upon the owner's taste and the amount of land available. An acre would support a good all-round family orchard of about seventy trees. Given sufficient irrigation water, with favorable climatic conditions, one may select as many different kinds as desired. Usually, however, one should limit the list to, say, apples, peaches, plums, pears, cherries, walnuts, and almonds rather than try to grow everything that could be grown; increasing the number of species also increases the difficulties of management.

Climatic conditions permitting, one or more citrus trees should be grown for ornament if for nothing else. A small space should also be devoted to berry fruits and grapevines, the latter being ornamental as well. If the area available is only the size of the average country garden or city back yard, the selection will depend upon personal preference.

Space permitting, one should try to have a succession of fruits from the earliest until the latest. Since one or two cherry trees are only tantalizing because the birds will usually get all the fruit, cherries may be omitted, and the list started with an early peach (freestone if possible); then another peach or two ripening at later dates; then an apricot, a Japanese plum, a summer apple, a European plum or prune, and one or two late varieties of peaches or nectarines. In late June and July there will be berries of all kinds, although strawberries will begin to ripen as early as April. It is also easy to have grapes from July until frost. Grapevines may be trained on a fence, against a wall, on an arbor, or on a simple wire trellis. Bushberries do reasonably well in clumps stowed away in a corner or trained against a fence or a two-wire trellis. Except in cool locations, strawberries are rather troublesome because they need frequent and regular irrigations; but a few hills will yield a surprising amount of fruit. In general, shallow-rooted small fruits of all kinds will not endure so much neglect as the deep-rooted tree fruits. The wise amateur, having studied his own virtues and limitations as a husbandman, will choose his fruit collection accordingly.

Along the coast an apple tree is always a safe choice. Pears also do well there and need about the same treatment as the apple, particularly as to pruning and spraying. Walnuts, apricots, European plums, and cherries thrive in the coastal valleys. In the interior valleys and foothills, practically everything would do well except apples. Even there, early apples can be grown, though late ones will not ripen properly.

Cherries, almonds, Calimyrna figs, dates, and (to some extent) plums, pears, and apples have pollination difficulties. There is even one peach, the J. H. Hale, that requires a pollinizer. All varieties of almonds and most of the cherries will not set fruit with their own pollen, and apples and pears are better for being cross-pollinated. One almond or cherry tree (except sour cherry) would be useless unless the proper varieties were growing in a neighboring garden so that the bees might carry pollen for cross-pollination. One of the branches may be grafted to another variety that will supply pollen for the rest of the tree, but this work must be done by the owner after the tree is planted rather than by the nurseryman before it is purchased.

#### CARE AND MANAGEMENT

*Selection of Trees.*—There are many good nurseries where deciduous fruits are propagated. Some in the south specialize in propagating citrus and subtropical fruits. Since nurseries in the central part of the state usually handle citrus trees on consignment from southern nurseries, one may generally buy whatever he wants from a single firm. Do not buy from tree peddlers. Order trees as early in the autumn as possible, for tree digging begins in December, and shipment usually in January. Specify one-year-old trees. This means that the top consists of one season's growth, although the roots (because of the necessary steps in propagating) will usually be two years old. Older trees are more difficult to transplant and do not come into bearing any earlier than the young ones.

Upon receiving the trees, unpack them at once, bury the roots in fresh soil, and leave them there until ready to plant. Citrus and other evergreens are balled by the nurseryman; that is, the trees are dug with a mass of undisturbed soil about the roots, and the whole is securely wrapped in burlap. These, too, should be "heeled in" until ready to plant.

*Spacing Distances for Planting.*—Fruit trees are spaced, in planting, according to the size they will normally attain when full grown. Since available moisture is an important factor in their growth, crowding will tend to make them smaller. If badly crowded they will be tall and spin-

dling, with the fruit confined to the extreme top. A deep, fertile soil makes a larger tree of a given species than does a poor or shallow soil. Species, and sometimes varieties, have their own peculiar habit of growth, some being slender and upright, others low and spreading. The shape may also be considerably modified by the pruning system employed.

Dooryard trees are usually not planted in rows; but whether they are or not, every tree should have room to develop properly. Trees in a single row may be closer together than trees placed in rows both ways, provided there is plenty of room on each side.

Walnuts and pecans require the most space—from 50 to 60 feet each way or a corresponding area if they are not in rows. Apples and apricots come next with a need of 25 to 30 feet each way. Almonds, cherries, and pears will vary from 24 to 26 feet; peaches and plums from 18 to 24 feet, with an average for the peach of 18 to 22 feet. Prunes have approximately the same requirement. Since avocado varieties vary considerably in size, the range of planting will be 25 to 40 feet. The same is true of figs: the Kadota requires only 20 to 24 feet, whereas the Mission will need at least 40 feet between trees. Oranges, lemons, and grapefruit are usually planted 22 to 24 feet apart; and persimmons will range from 15 feet each way in foothill soils to 24 feet in the valleys.

*Interior Plant-Quarantine Inspection.*—The State of California maintains plant-quarantine inspection at all interior points through the county agricultural commissioners and their assistants, who inspect all plants, nursery stock, seeds, bulbs, and other plant material, moving interstate and intrastate. This service aims to exclude or check dangerous agricultural pests—that is, any insect, disease, animal, weed seed, vegetable matter, or other form of life dangerous to the agricultural industry of the state.

Packages of plants and seeds arriving by common carrier are held by the latter for inspection, normally made before delivery to the consignee. Packages so inspected bear the mark of the agricultural commissioner or inspector of the county involved. Plant material moving within the state by channels other than common carrier must carry a blue shipping permit, obtainable from the county agricultural commissioner at the point of origin, to give warning that inspection at the destination is required. By state law, plants carrying the blue shipping permit but not labeled, inspected, and passed, should be shown, before planting, to the nearest agricultural inspector or to the agricultural commissioner of the county of destination. One should not accept gifts of plants without having them officially examined before they are unpacked for heeling-in or

planting, since several pests, including noxious weed seed, may be acquired in this way.

The inspection of plants and plant products by the county agricultural commissioners and their assistants is supervised by the Bureau of Plant Quarantine of the State Department of Agriculture at Sacramento. The commissioner's office is usually located in the county courthouse.

*Planting.*—Deciduous trees should never be transplanted nor have their roots disturbed while they are in leaf—that is, in a growing condition. Evergreen trees, on the other hand, may be planted at any time if the roots are balled, although in the north it is best to wait until danger of frost is past. The amateur who must transplant an evergreen should first dig a trench around it (down below the side roots), shave off as much of the earth around the tree as will leave most of the root system intact, enclose the ball with burlap, and wrap it securely with heavy twine. Evergreen shrubs are usually grown in pots or tin cans and are successfully planted even in late spring. For best results, however, all woody plants, both evergreen and deciduous, should be in the ground early enough to receive at least one good soaking rain. Of course the climate is a factor : where no rainfall can be expected, the garden hose or a pail of water may be used to settle the soil about the roots as the hole is being filled; but the job should be finished with a shovelful of unwet soil.

Deciduous trees and shrubs may be planted at any time between the falling of leaves in autumn and the swelling of buds in spring. In most parts of California, January is the best time because the ground will then have been moistened by rains and more rain will come to settle the soil about the newly planted trees. The size of hole for receiving a tree will depend upon the condition of the land. If the soil has been plowed or spaded deeply at some time before planting, the hole may be just large enough to let the roots spread naturally without crowding, but somewhat deeper than the root system in order to permit the placing of a shovelful of fine soil in the bottom. If the soil is firm and uncultivated, the hole should be much wider than the root system; but otherwise it should be as stated above. Try to plant the tree at the same depth it stood in the nursery. Deep planting is dangerous, for if any part of the trunk is buried, unless the soil is very sandy, the tree may die the first season. Although a few trees survive deep planting by forming a new root system above the old one, this does not happen often. Do not unduly expose the roots to sun and wind while planting; keep them covered with wet burlap until wanted.

Before planting a deciduous tree, give the roots some attention by

cutting out the very fine ones that have become dried in handling; also remove broken or badly damaged parts, and shorten those that remain to a length of 6 to 10 inches. A young deciduous fruit tree and a walnut tree ready for planting are shown in figure 1. The taproot, if any, will have been cut off when the trees were dug in the nursery.

Do not attempt to plant a tree in soil that is too wet; it should be friable and easily handled with a shovel. If uncertain, try squeezing a handful to see whether it becomes doughlike, with particles of water glistening on the surface. If it does, it is too wet for planting. This test applies to top soil or loam, not to pure clay.

Set the tree upright, and adjust it to the proper depth. Since root systems vary, it may be necessary to place more soil in the bottom of the hole for the tree to rest on. One person should hold the tree, and another gradually shovel in fine soil that will sift down between the roots. This process should be assisted by gently agitating the tree or by pressing the soil between the roots with the hands. Wherever possible, firm the soil under the roots with the foot. When the first roots have been covered, press the soil down firmly. After the remainder of the soil is filled in, continue to firm it by trampling. When the planting is finished and a final shovelful of fine soil has been spread without trampling, the ground should be level. A good test to find whether the tree has been set properly is to see whether it can be lifted out with one hand. If so, one should plant it again, this time firming the soil better around and between the roots. This test does not hold good if the soil is sandy or too dry for proper planting. If the soil is a little too dry, water thoroughly; and then mulch it, to prevent cracking, by spreading a shovelful of earth around the tree. A good rain has often corrected a bad job of planting.

In planting a tree, one is tempted to put fertilizer in the hole in order to hasten the growth. Although this can be done, mineral fertilizers like nitrate of soda and sulfate of ammonia should be avoided, as they are too caustic for the roots. If the hole has been dug 5 or 6 inches deeper than necessary, a shovelful of manure may be placed in the bottom and then covered with 4 or 5 inches of soil. The roots might be killed by direct contact with fresh manure. Likewise, the bark may be injured or killed by fresh manure banked against the trunk of a newly planted tree. One may safely use well-rotted manure mixed with the soil in planting and also spread it around the trees. A good commercial fertilizer to use after planting would be dried blood,  $\frac{1}{2}$  pound of which may be spread in a 3-foot circle about the tree and raked in. This material could with safety also be used in the hole.

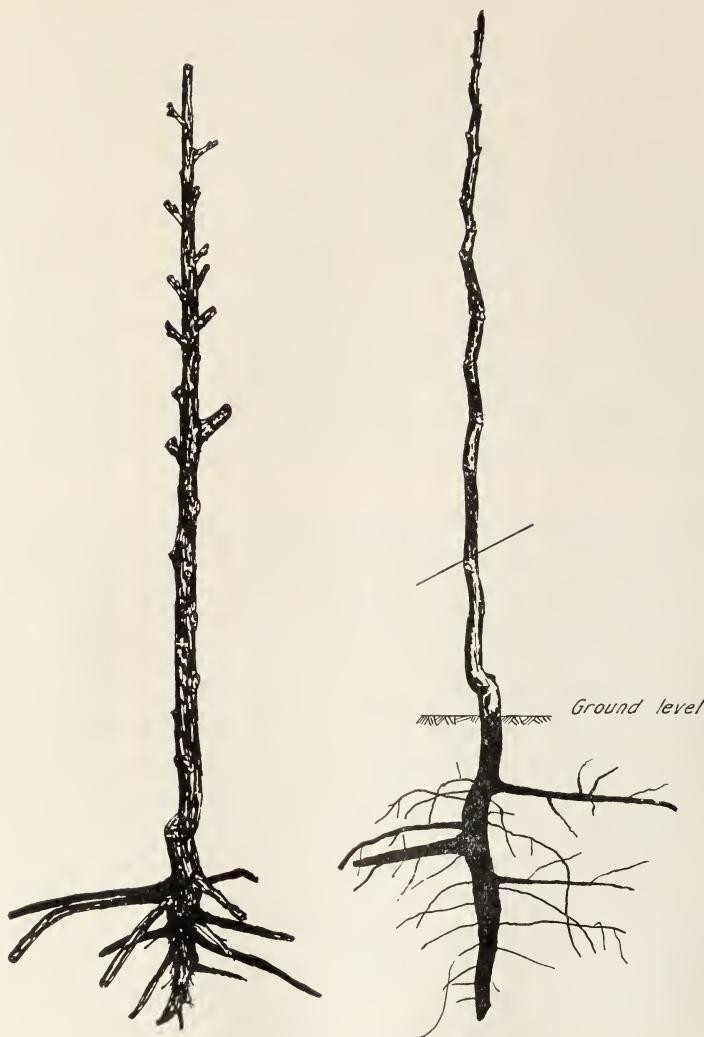


Fig. 1.—At the left is a young tree ready for planting, cut back to a height of 24 to 30 inches. If there are side branches, they are cut back to a single bud. At the right is a walnut tree ready for planting. The usual practice is to cut walnuts back to a height of 3 or 4 feet; but in the warm valleys sunburn may kill most of the buds, and it would be safer therefore for the amateur to cut back to three buds (8 to 12 inches from the ground) and grow a new head from the most vigorous sprout.

*Protecting against Sunburn, Rabbits, and Flat-Headed Borers.*—In hot locations some protection against sunburn will be needed for the first two years. Do not, however, paint the tree trunk with any mixture containing tar or creosote, for such an application will kill the tree. One protective method is to apply a good coating of whitewash; another is to wrap the trunk lightly with burlap or, better still, with a special wood-veneer wrapper made for the purpose. Four thin boards carefully driven into the ground to enclose the tree will protect it from sunburn and also from rabbits. If there is no sunburn, there will be no flat-headed borers. Burlap wrappers, if used, should be removed as soon as cool weather begins in the autumn. If whitewash is applied a new coat must be given each year. In hot regions a local injury from sunburn has been observed around the borders of the wound made by cutting off the seedling after budding. The preventive measure is to plant the tree so that the scar will be on the opposite side from the early afternoon sun instead of facing it.

*Irrigation.*—Because of the variation in rainfall in California and the inadequate distribution throughout the year, fruit trees must generally be irrigated.<sup>2</sup> The precipitation varies from a few inches in the southeast to 5 or 6 feet or more along the northwest coast; but the rains are mostly confined to the winter months, whereas the heavy demand for moisture to support the leaves and fruit occurs in the summer.

The water requirements of fruit trees cannot be fully discussed here. As a general rule, however, if the winter rains have not wet the soil to a depth of approximately 6 feet, the deficiency should be made up by an early-spring irrigation. The amount of regular irrigation will vary with climatic conditions as well as with the kind and depth of soil. Along the coast less moisture will be needed because of cooler weather and summer fogs that reduce evaporation. In the interior, however, more water will be demanded because of high temperatures and long periods of almost unbroken sunshine, which cause a heavy transpiration of moisture from the leaves, and thus create a maximum demand for water by the roots.

Under some coastal conditions fruit trees can be grown without any irrigation at all; they may have to be watered a few times while young, but afterward they can maintain themselves on the rainfall. Such trees would, however, do much better if irrigated two or three times a season.

In the back-yard garden, fruit trees are usually irrigated from the domestic water supply; the expense is usually not prohibitive. In the interior valleys trees should not be planted unless they can be watered

<sup>2</sup> Veihmeyer, F. J., and A. H. Hendrickson. Essentials of irrigation and cultivation of orchards. California Agr. Ext. Cir. 50: 1-24. 1936.

at least three times a year: first in March or April, if there has been deficient rainfall, or in June, if the rainfall has been normal; and then at monthly intervals, preferably until September. Even in the interior some trees may root so deeply as to live for several years without irrigation; but they will produce little or no fruit.

As a rule trees on sandy soils are irrigated frequently, with relatively small amounts of water, because of the limited moisture-holding properties of this type of soil. On heavy soils, on the other hand, irrigations are given at longer intervals, but more water is used each time. Of course the total amount required during the season will vary with the size of the tree, large trees requiring more water than small ones.

Sometimes the amateur may think he has wet the soil thoroughly when he has not. A sprinkler, if used, may well be left running all night. With the soil wet to the proper depth all summer, it is not necessary or desirable to irrigate late in the fall; and watering after the leaves are off would be useless.

*Cultivation.*—In the home garden, fruit trees will need no cultivation except light hoeing to keep down the weeds in the area likely to be occupied by the root system. Weeds must be kept down, for they use more of the precious soil moisture than the young trees do. Trees planted in a fertile, well-watered lawn usually thrive without any cultivation.

*Pruning.*—Before deciduous trees are planted, or immediately afterwards, the tops should be shaped so that growth will be directed properly. The ideal tree will be vase or goblet-shaped, starting with three primary branches. These, theoretically, will divide into five or six branches at the end of the second season's growth. The next year some of these will subdivide again. If all grew there would not be room for them without undue crowding.

A wide-spreading tree like the apricot should have five or six scaffold branches at 5 feet from the ground. Above this height there may be further branching, so that the number in the end will depend upon the height of the tree. In any case, the fruiting parts should have ample room. Too many fruiting branches or fruit-bearing twigs may make the fruit so small as to be almost worthless and may cause the spurs to die out. Crowding also makes it harder to protect the fruit from diseases and insects.

Practically all pruning should come while the trees are dormant; summer pruning, though helpful in maintaining a proper shape, is a weakening process. Recommendations for pruning young deciduous fruit trees may be summarized as follows:

Young trees must be cut back at planting in order to balance the loss

of the roots removed in digging from the nursery. Only three main or "scaffold" limbs are ordinarily desirable. Wherever possible, 6 to 8 inches of trunk space should intervene between adjacent scaffolds. Deciduous trees when purchased may or may not have side branches. If not, merely cut the whip back to a height of 24 to 30 inches. If there are branches, stub them all back to a single bud (fig. 1). For the later train-

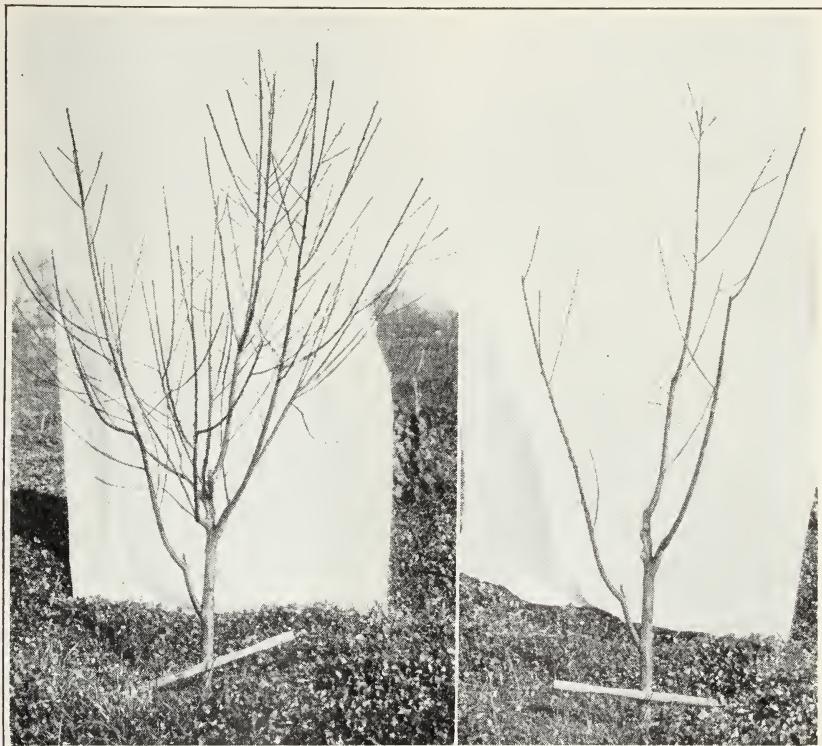


Fig. 2.—Peach tree after one season's growth; before and after pruning. (From California Agr. Ext. Cir. 98.)

ing of young fruit trees, see figures 3, 6, 10, 26, 27, 30, 31, and 32. The general principles of training are approximately the same for all deciduous fruits. The aim is to have three so-called "scaffold branches" spaced from 6 to 9 inches apart and arranged spirally around the trunk. Perhaps all the buds on the whip will begin to grow shortly after planting, and half or more will make branches. Out of the number select the three that are best placed, and pinch back the others. This is done in May or early June of the first season. At the close of the season, preferably in January, the first pruning may be given. Despite the summer pinching, if growing conditions have been favorable, there will be a mass

of branches to contend with. Usually, however, the three that were favored will have dominated all the rest, and the original plan can be carried out by cutting away those that are not wanted (fig. 2). A year later, trim out the superfluous parts and select the secondary branches (a total of five to seven) that are to complete the permanent framework of the head (fig. 3). Stone fruits like the peach and apricot are generally



Fig. 3.—Two-year-old peach tree before and after pruning. (From California Agr. Ext. Cir. 98.)

headed lower than pome fruits like the apple and pear; and the walnut will be higher still. This practice is dictated by the habit of growth that the trees will assume later on. If the bottom branch is started 18 inches from the ground, it will always remain at that height; and there will be no changes in the distances between the branches. This statement refers to the center of each branch, for all will increase in diameter, and their enlargement will decrease the actual space between them as well as the actual distance from the ground. The trunk of the tree does not, as in the popular belief, undergo a process of stretching that will eventually raise all the branches higher and higher. For further information about pruning consult the discussions under the different fruits.

After securing the desired number of main branches with proper spread, one gains nothing by a further heading back. Lightly pruned nonbearing trees have stockier and stronger trunks and branches than

trees heavily pruned. The lighter the pruning, the greater the development. To check the development of any branch or part, cut it heavily. To encourage it, prune it lightly or not at all. Lightly pruned trees come into bearing from one to three years earlier than those heavily pruned, and this early bearing is not incompatible with future productivity.

Summer pruning is weakening and results in somewhat smaller trees. Early summer pinching back of surplus shoots the first and second summer is, however, usually beneficial; it strengthens the shoots left untouched and reduces the pruning necessary the following winter. Summer pruning in later years may sometimes be desirable, especially where there is a tendency to shade out the interior of the tree. Much of it can be done at fruit-thinning time by plucking out the excess sprouts that have arisen in the center and in other parts of the head.

In pruning a bearing tree the principal aim is to maintain the proper balance between vegetative or wood growth and fruit production. Excessive growth is made at the expense of fruit production, while over-bearing is generally accompanied by shorter growth and if continued for several years will probably diminish the vigor. The ideal condition is to have the trees making moderate growth each year, thus increasing and maintaining the fruiting area while bearing a large but not an excessive crop. Heavy pruning, especially a heavy cutting back of the young growth to stubs, tends to increase vegetative growth, whereas light pruning (the thinning out of undesirable branches and perhaps of some twigs on the remainder, but without cutting them back) favors fruit-spur formation and fruit production, along with shorter vegetative growth.

If bearing trees are pruned by severely cutting back the new growth each year, they often devote too much energy to the growth of long shoots and not enough to fruit production. The fruiting wood of the interior and lower portions is often shaded out by the dense top growth. Peaches and, to some extent, apricots and Japanese plums are conspicuous examples of trees that bear their fruit buds on twigs produced the last growing season. These buds occur in clusters of three each, the small center one being usually a wood bud. Apples and pears, on the other hand, produce most of their fruit on short spurs where nearly every growing tip is terminated by a fruit bud. Cherries and plums bear some of their fruit on the sides of twigs, but most of it on spurs. On the Japanese plum these spurs are very numerous and very short.

Since the main limbs should be clothed with fruiting wood, the tops of the trees should not be so dense as to shade out fruiting parts below.

Trees tend to form their fruit buds where they receive the most sunlight. While the center of the tree should be moderately open to favor the formation of buds and the proper ripening and coloring of the fruit, it should not be too open, because of the danger of sunburning the wood.



Fig. 4.—Dooryard Japanese plum trees.

Many species of fruits, but particularly apricots, peaches, and Japanese plums, set such heavy crops in most parts of California that the fruit must be hand-thinned if desirable size and quality are to be secured. Since thinning is tedious and costly, the distribution of the fruits should be regulated, as far as possible, by pruning. But even then some thinning will be necessary, especially with apricots, peaches, and Japanese plums (figs. 4 and 32).

The exact pruning treatment selected will depend first upon the fruiting habit of the tree and second upon the amount of new growth it is making.<sup>3</sup>

*Top-Grafting.*—Sometimes it is desirable or necessary to alter the variety of a tree that has already been planted. This change can be safely made, even after many years, by grafting. If the tree is no larger than 3 inches in diameter, the trunk can be sawed off below the bottom branch, the stump split open with a hatchet or long-bladed knife, one or two scions of the desired variety inserted, and the wound sealed up with grafting wax or with some other material obtainable from nurserymen or dealers in orchard supplies. Old trees should be top-worked by grafting the main branches. If a graft fails to grow, the sprouts arising from the stump may be budded. Although grafting is done in spring when the buds are swelling, the scion must be perfectly dormant—that is, the scion wood must have been collected earlier and kept in a cool place until needed. Budding is done in July or August or at any time when the bark will lift and when dormant buds can be secured.

Though all fruits can be grafted or budded, some are more difficult than others. Apple and pear grafts grow easily; plums, prunes, cherries, apricots, and almonds are rather more difficult; and peaches and walnuts are difficult indeed for the amateur. On the other hand, the peach is about the easiest of all to bud, and the walnut is the most difficult for the beginner.

If desired, each branch of a tree may be grafted to a different variety. For example, one peach tree may be caused to produce several different varieties of peaches that ripen at different dates, say from June to August. Or this same peach may be made to bear peaches, almonds, nectarines, apricots, Japanese and European plums, any of which can be grafted or budded upon the peach, although cherries, apples, and pears will not grow upon it at all.<sup>4</sup>

Growing several different species or varieties of fruit on the same tree in this manner is a spectacular feat and a great curiosity. Commercially, of course, it is impractical because there is then not enough fruit at any one time to be of much use. For the amateur, nevertheless, it may offer a way of deriving enjoyment from home fruit-growing.

*Spraying.*—The home owner is at a great disadvantage in fighting insects and diseases that attack his trees or his fruit because he may not consider it worth while to provide the necessary equipment and mate-

<sup>3</sup> Tufts, Warren P. Pruning deciduous fruit trees. California Agr. Ext. Cir. 112: 1-67. 1939.

<sup>4</sup> Hansen, C. J., and E. R. Eggers. Propagation of fruit plants. California Agr. Ext. Cir. 96: 1-52. 1936. (Revision in press.)

rials for spraying. Unfortunately it is necessary to spray such fruits as the pear and peach and sometimes others if satisfactory fruit is to be produced; all fruits and nuts require some spraying, dusting, or fumigating. On the market there are many types of small sprayers suitable

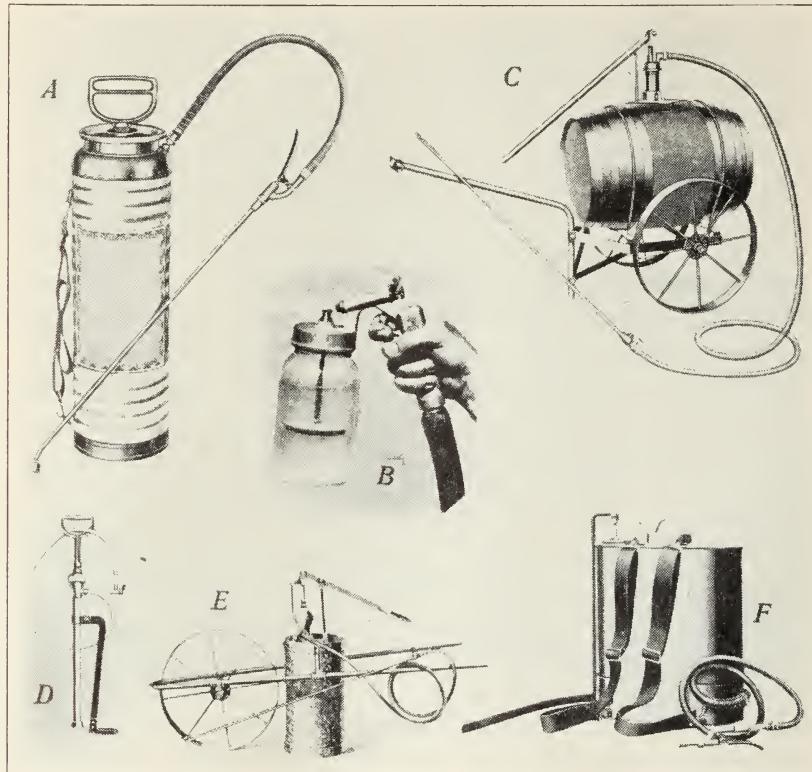


Fig. 5.—Types of low-cost spraying equipment. Prices will range from \$3 to \$30. Type *A* is operated by compressed air, by hand. For low-growing things, a device as shown in *B* is attached to a garden hose; the power comes from the water system. The concentrated spray solution is contained in the jar, and its flow is released by pressure of the finger on the trigger. At *C* is shown a rather large outfit powered by a hand-operated pump and capable of handling an acre of mixed species that need not all be sprayed at the same time. *D*, An old-fashioned bucket sprayer, very powerful, capable of spraying the tallest tree, and excellent for half-a-dozen trees or even more. *E*, A small example of type *C*. A knapsack outfit is shown at *F* that the operator carries on his back and pumps as he goes; this is best adapted for use on low trees and shrubs.

for the owner of only a few trees. These range from a small device that is attached to a garden hose to a barrel pump mounted on wheels; and prices vary from \$3 to \$30. For \$15 or \$20 one may buy a spray pump with a 10-gallon tank that is pushed like a wheelbarrow (fig. 5). This would be large enough to take care of twenty to thirty trees. Although

one man can operate the pump and direct the spray, a helper is almost indispensable, particularly if it is necessary to climb a ladder to reach the upper branches. By attaching the nozzle to a 10-foot spray rod, however, one can stand on the ground and reach the tops of most ordinary garden trees.

#### DESIRABLE FRUITS AND NUTS OF CALIFORNIA

The discussions that follow include most—but not all—of the fruits and nuts that can be successfully grown in California. Several that are obscure or extra tender are intentionally omitted because they would probably be unsatisfactory for the amateur. Only a limited number of the most reliable varieties of the different fruits and nuts are discussed. Lists of varieties adapted to various districts are given on pages 79–81.

*Users of spray materials should bear in mind that many of them are highly poisonous and should be handled with proper caution. In all cases they should be stored where inaccessible to children or livestock.*

**Almond.**—In sections where the red spider<sup>5</sup> is not naturally bad or can be controlled, the almond is a satisfactory tree for the home garden because it usually requires little attention aside from a thorough irrigation about the middle of July. Two additional irrigations, one in June and another after the nuts are harvested are advisable. As the almond likes a warm dry climate, it is well adapted to the hot interior valleys. Although it will grow along the coast, other things would be more satisfactory there. The trees have much the same hardiness against cold as the peach and so have about the same distribution. In planting, areas of late spring frosts are to be avoided because the almond blooms very early. In Los Angeles County and southward the warm winter temperatures are apt to bring it into bloom even while there is still danger from the normal winter frosts.

After reaching bearing age the almond requires little pruning. Merely remove interfering branches, and do not let the head become too dense. It is well to harvest the almonds when the hulls begin to crack open and the nuts start to drop. If they are left on, they will be injured by the birds; and those that fall will be quickly attacked by ants. After being hulled, the nuts should be dried several days in the sun before storing.

As almonds do not set fruit from their own pollen, two varieties are necessary to secure pollination. For this purpose the best two are the Nonpareil and the Ne Plus Ultra, leading varieties that successfully pollinate each other. If a third variety is desired, include the Peerless.

<sup>5</sup> For the scientific names of the insect pests and further discussion see: Essig, E. O., and W. M. Hoskins. Insects and other pests attacking agricultural crops. California Agr. Ext. Cir. 87:1–155. Reprinted 1939.

Almonds are borne largely on short spurs, although some are found on one-year wood, especially in certain varieties. For economy's sake the pruning of bearing trees is usually largely restricted to the removal of limbs  $\frac{1}{2}$  to  $1\frac{1}{2}$  inches in diameter wherever they are too thick; little



Fig. 6.—A well-grown six-year-old Nonpareil almond tree.  
(From California Agr. Ext. Cir. 103.)

or no time is spent in thinning out the one-year shoots. This practice seems to have given good results. Bearing almond trees are usually not expected to make more than 8 to 15 inches of new growth annually. The fruiting branch remains economically productive for about five years (fig. 6).

Armillaria, or oak-root fungus, is a disease that attacks the roots and crown of nearly all fruit trees. Its presence is indicated by declining vitality of the tree and by the appearance of mushrooms around the base of the trunk following warm rains in winter after the tree is dead. Trees may live three or four years after being attacked but often die in a year or two. The disease spreads from tree to tree as the healthy roots come into contact with diseased ones. It is easily identified by the grayish, fan-shaped mycelial growth on the underside of the bark at or near the surface of the ground (fig. 7). If a tree dies of the disease, it is useless

to plant another one of the same kind in the same place. Only walnut on black walnut root, pears on French root, and figs are resistant; and even two of these, the walnut and pear, are occasionally attacked.



Fig. 7.—White, leathery, fan-shaped growth of oak-root fungus beneath the bark of an almond tree. (From California Agr. Ext. Cir. 98.)

Crown gall, a bacterial disease, attacks nearly all tree and bush fruits (fig. 8); the almond is very susceptible. Galls or large warty knots form on any part of the roots, but particularly just below the surface of the ground on the main roots and about the crown of the tree. Under good growing conditions the trees may be affected throughout their lifetime and still bear satisfactory crops. The greatest danger is that the crown infection may girdle the trees. Galls at this point should be chiseled off every year or two, and the wounds treated with a bordeaux paste<sup>6</sup>

<sup>6</sup> Formula for making bordeaux paste:

A { Bluestone.....12 pounds	B { Quicklime.....24 pounds
Water.....8 gallons	Water.....8 gallons

Dissolve the bluestone and slake the lime separately in the amounts of water specified. Then mix together equal quantities of *A* and *B*, making up only enough for each day's use and diluting to the strength desired. The excess lime makes the material sufficiently thick to apply as a paint. It is useful as a repellent for tree-boring insects.

or some other disinfectant and then covered with grafting wax or even with a lead-and-oil paint, to prevent reinfection.

The shot-hole disease of almonds is caused by the same fungus as peach blight and the same treatment may be used (page 62).

The common red spider, or two-spotted mite, is the worst of the four different mites that may attack almonds. It appears usually in June, often in the tops of the trees or at the tips of branches, where it spins a



Fig. 8.—From left to right, crown gall on almond, apricot, plum, and peach. Galls at the crown or above the root system are more dangerous than those lower down or on the laterals, as they may girdle the trees. Only the galls near the surface of the ground can be reached for treatment. They are chiseled off, and the wounds covered with bordeaux paste.

fine web on the leaves, generally on the upper surface. It sucks the plant juices from the leaves, which soon assume a yellow, mottled appearance, die, and drop off. The trees may be completely defoliated by the end of August; affected trees are very unsightly. The almond mite does not spin a web. It works on the small twigs as well as on the leaves; and though it may cause serious injury, it rarely defoliates the tree. Most of the damage by these mites is done in spring and early summer.

Thorough watering of the trees will discourage the appearance of red spider, as will also the killing of adjacent host plants, such as malva and wild morning-glory. Spraying in late winter, just before the buds open,

with 4 per cent commercial dormant oil emulsion<sup>7</sup> (4 gallons of the solution to 100 gallons of water), will destroy the eggs of the almond mite; and during the growing season a summer oil solution, 1 to 100, will kill the mites themselves.

The Pacific peach tree borer and the peach twig borer are discussed in the section on the peach.

*Apple*.—The apple has such a wide adaptation to climatic conditions that trees can be grown in every county in the state. The late varieties



Fig. 9.—White Astrachan apple tree thirty years old,  
University Farm, Davis, California.

are unable, however, to ripen their fruit in the hot interior valleys; the apple is best adapted to the cool coastal region and to low mountains. Although the trees are not injured by a winter temperature of 20 degrees below zero or even lower, the higher the altitude the greater the danger from late spring frosts that might kill the blossoms. Valuable though the apple may be as a fruit, it is often a disappointment as a dooryard tree because of the difficulty in controlling codling moth; few home owners have the proper spraying equipment.

The soil should be well drained, but the apple tolerates a wetter soil than any other fruits except the quince, the plum on Myrobalan root, or

<sup>7</sup> The owner of a few trees cannot well make a home mix of several of the sprays and dusts. He had better purchase them in small quantities, as needed, from seed dealers or dealers in orchard and garden supplies, and follow the manufacturer's directions for using.

the pear on French root. For the first ten years particularly, the tree will require considerable pruning to keep the head open and to prevent the crowding of fruiting parts. Figure 9 shows a well-shaped White Astrachan apple tree.

Apples yield most of their crop on long-lived spurs, the economic productive life of which is seven to eight years. The fruit is produced from a terminal bud one season; the next season the spur elongates a little and sets another terminal fruit bud; and the following season fruit is produced again. Apples tend to be alternate bearers, although this tendency is less marked in California than in the East. Pruning should consist mainly in a judicious thinning-out of the new shoots, with the occasional removal of a larger limb.

Varieties suitable for the apple-growing regions of California are as follows:

Mountains: Benoni—red, early, blooms late and therefore escapes frosts when others are killed. Red June—red, sprightly, good quality, early. Grimes Golden—yellow, juicy, aromatic, of high quality; ripens in late summer. Jonathan—red, juicy, acid, of high quality. Spitzenburg—red, juicy, very acid, of highest quality; ripens late and is a good keeper. Delicious—large, long and tapering, with five prominent knobs at the blossom end; light red, very juicy, aromatic, mildly acid but of very high quality; late fall or early winter. Winesap—red, juicy, acid; ripens in late fall and is an excellent keeper. Arkansas Black—red, rich, juicy, less acid than Winesap; ripens in late fall and is a good keeper.

Coast and coastal valleys: Alexander—an early apple, red or striped, rather coarse, good for cooking. Gravenstein—red-striped, tender, crisp, acid, aromatic, ripens in late summer and is of good quality but is not a late keeper. McIntosh—crisp, tender, very aromatic, subacid, of high quality, ripening in the fall. Yellow Bellflower—yellow with prominent dots and pink blush, large, long tapering, ribbed, tender, juicy, subacid, not of high quality; ripens in September. Golden Delicious—medium to large, oblong conic, clear yellow, smooth to somewhat ribbed; flesh firm, crisp, tender, juicy, aromatic, mildly subacid; of very good quality; ripens in the fall. Yellow Newtown—large, roundish, green to yellow, often with greenish-red cheek; firm, crisp, juicy, of very good quality; harvested in October and is an excellent keeper.

Interior valleys (summer varieties only): Red Astrachan—red, medium-sized, juicy, crisp, sprightly subacid, of medium quality. Yellow Transparent—greenish to whitish yellow, tender, sprightly subacid, inclined to be mealy when overripe, of medium quality. Gravenstein—an important coastal apple (see above) that is proving to be the best all-

round summer variety for the warm Sacramento and San Joaquin Valley climate, where the fruit of winter varieties sunburns before ripening.

Southern California: At elevations of around 2,500 feet or higher, varieties as listed for either mountain or coastal valley conditions will be found satisfactory with the limiting factor of spring frost. On the warm valley floors, if an apple tree is desired, though not advised, the Winter Pearmain, Delicious, and Winter Banana will perform better than other varieties. Crab apples would do well.

Where cold-storage facilities are not available, late-ripening apples may be held for several weeks or months if kept in a cool place like a cellar, where they do not warm up during the day. Winter varieties such as Newtown and Winesap may be kept until April or May by burying them in the ground. In a well-drained place, dig a shallow pit (12 inches deep), line it with straw, pour in the apples (a cone-shaped pile), spread a 4- or 5-inch layer of straw over the fruit, and then cover the mound with soil to a depth of 4 to 6 inches. A hole may be made in the side, and fruit taken out as needed, the opening being stuffed each time with straw.

The worst diseases of the apple are fire blight, the same bacterial disease that attacks the pear tree; mildew, which affects leaves and young fruit; and scab, which disfigures the fruit. Cut out the blighted twigs well below the point where diseased areas show; spraying does no good. Mildew is a white powdery growth that covers leaves and shoots, and thus checks the growth and distorts the parts. It is especially serious in foggy sections. Cut out mildewed twigs as thoroughly as possible in winter. Scab may be bad along the coast. It causes velvety dark moldy patches on young fruit and sometimes on the leaves and twigs, and rough corky spots on mature fruit, which is badly distorted. Spray with 2-2-50 (see footnote 7, page 26) bordeaux mixture or with 1-20 lime-sulfur as the buds open in the spring, and again when the petals are falling.

Codling moth, the worst insect of the apple, so thrives in the California climate that one can seldom grow apples without spraying the trees. Two or three applications of standard lead arsenate (see footnote 9, page 30), 3 pounds to 100 gallons of water, are necessary, first when the petals begin to fall and once or twice more at intervals of a week or 10 days. The first, or calyx, spray is the most important and can be applied properly only when the pump can deliver a high pressure—up to 300 pounds. If aphids are present on the young leaves, add  $\frac{1}{3}$  pint of nicotine sulfate. Do not let the drip deposit on vegetables or berries near the sprayed trees; cover such plants with burlap or canvas before spraying. Burying or burning the wormy windfall fruit and banding the tree trunk in late summer are good supplementary control methods. A band placed around

the trunk below the branch system will halt many "worms"<sup>s</sup> that have emerged from fallen fruit and are climbing up the trunk to seek a place in which to hibernate until they change into the moth stage. For this purpose there are two kinds of bands—one made of burlap, and the other made of a chemically treated corrugated paper. The burlap is effective only if it is removed every ten days and the hibernating worms destroyed, whereas the chemical paper kills the insects and therefore need not be taken off until winter. A new paper band must be put on each summer or when the first worms begin to leave the fruits.

The usual practice is to apply these bands early in June and leave them on until February. If not applied in June, they may be fairly beneficial if applied in September and October, before the rains, for there is often a migration to the tree trunks when the top soil becomes wet and cold. On both apples and pears the rough bark should be scraped from the trunk during the winter in a ring 4 or 5 inches wide and approximately 18 inches from the ground. Late in May or early in June the band should be applied single thickness to this cleaned area. The ends, which should overlap about an inch, should be held tightly to the tree by a small staple or a tack.

San Jose scale is found on the bark of the trunk and branches and also on the fruit, causing conspicuous red spots with a white center on the mature apples. Spray with lime-sulfur 1-10 or, better still, with commercial dormant oil emulsion 5-100 (see footnote 7, page 26) in mid- or late winter.

The woolly aphid, which attacks the tree both above and below ground, may be troublesome in coastal areas, though inland it is of but minor importance. It is easily distinguished by the reddish bodies completely covered with white woolly wax. Spray the parts aboveground in winter with 5 per cent commercial oil emulsion (see footnote 7, page 26) to each 100 gallons of which has been added 3 pounds of caustic soda or 2½ gallons of lime-sulfur. For treating parts below ground, use 2 to 4 ounces of paradichlorobenzene—PDB for short—spread in a ring around the tree and covered with 3 or 4 inches of soil. The soil must be dry, and the temperature above 75 degrees Fahrenheit. Refuse tobacco stems and leaves buried around the base of the tree in contact with the main roots during the rainy season may help materially.

Cankerworm, a light-green larva, popularly known as the measuring worm, may attack the leaves in early spring. It is a greedy feeder and if numerous may defoliate the trees. Placing bands of tanglefoot around

<sup>s</sup> The common name "worm" is used in places in this circular, instead of the more accurate term "caterpillar."

the trunks will help somewhat, but it would be better to spray with pyrethrum in oil (see footnote 7, page 26) when the worms appear.

The red-humped caterpillar, red and yellow in color and 1 to 2 inches long with conspicuous red spots on the back, feeds in large colonies. A voracious feeder, it may in time defoliate limbs or entire trees during the spring and again in the fall. It spins no web. Cut out and burn twigs or branches on which it is still working; or spray with arsenate of lead.<sup>9</sup>

The western flat-headed borer attacks trees only when they are weakened or sunburned. It never attacks healthy trees. It forms a burrow in the wood just beneath the bark and may easily girdle a branch or even a large part of the tree. Dig it out with a knife, and cover the wound with a tree wax or with lead-and-oil paint.

The green and rosy apple aphids may attack the tips of the young growing twigs. They swarm along the veins and midrib of the young leaves, causing them to fold up. Kill the eggs by spraying with 2 per cent tar-oil emulsion (see footnote 7, page 26) before the buds open; after the insects appear, spray with nicotine 1-800, adding soap as a spreader.

*Apricot*.—Though the apricot can be grown in all parts of the state, it is not adapted to the northern and eastern mountains because of frost injury in spring. Although less severely affected by high winter temperatures than many other fruits, it does shed its fruit buds as a result of warm winters. It does not thrive under conditions of late spring fog such as those common along the coast and in the San Gabriel Valley; the skin cracks, and the fruit is wholly unsatisfactory. The trees, though hardy, bloom early. The apricot can be grown in the Imperial Valley, where the fruit ripens very early but the trees are short-lived. It should be irrigated often enough to keep the trees thrifty. Ordinarily three to five irrigations, the number depending on the soil and climatic conditions, should suffice. Shot hole and brown rot are the worst diseases in the interior, and brown rot in the coastal valleys.

The Royal is the most common variety. The Blenheim and Royal are so nearly alike that one is as acceptable as the other. The Tilton is less susceptible to brown rot, but it tends to bear every other year. The Moorpark, of highest quality, is a light bearer but matures after Royal and Tilton.

As the apricot usually sets too much fruit, it should be thinned se-

<sup>9</sup> Formula for making standard lead arsenate spray (for biting insects):

Standard lead arsenate (powder) .....	3 pounds
Water .....	100 gallons

To secure effective wetting of the foliage a spreader—for example, casein or blood albumin—should be used as recommended by the manufacturer.

verely when the fruits are  $\frac{3}{4}$  to 1 inch in diameter. On the long fruiting twigs there should be about 3 inches between fruits. Where brown rot is prevalent, fruits should never touch each other. Remove double specimens, or break up the pairs. Trees that overbear may set little or no fruit the following year. Also, unless they are vigorous and have been kept well watered, the fruits will be very small. Often, therefore, more than half of the fruits are removed. Thinning should be done while the wife is not looking!

Apricots bear most of their fruit on spurs, but some of it on one-year wood as with the peach. Since the spurs are rarely profitable for longer than three years, regular pruning is essential in order to renew them continually. For apricots, however, it should be mostly a "thinning-out" unless the trees are lacking in vigor. From 12 to 24 inches of new growth each year is a desirable amount for this fruit under most conditions (fig. 10).

For a discussion of armillaria, or oak-root fungus, see the section on the almond.

Bacterial gummosis causes cankers on the trunks and large branches and may also attack the blossoms, fruit, leaves, twigs, and dormant buds. The cankers are elongated dead areas on the bark, characterized by copious exudations of amber-colored gum. Where there is no gum, the bark becomes brown, moist, and sour. This condition, though sometimes called sour sap, should not be confused with the sour sap that develops in the roots of trees in very wet soil. In its early stages the disease may be cut out and the wounds sealed with a bordeaux paste (see crown gall, in the section on the almond) or with some other good protective covering.

Brown rot, the worst disease of the apricot, is especially bad in some coastal areas and latterly is becoming known in the interior valleys. The blossoms wither and die, and the affected twigs gradually perish as the fungus spreads. Passing down the twigs into the branches, it usually stops upon reaching old wood. It may affect most of the fruit-bearing twigs, and thus wipe out a crop. The best preventive is a bordeaux spray 8-8-50, applied when the blossoms are opening. In rainy weather, additional sprays will be needed. In moist locations the disease attacks the fruit particularly where it is growing in clusters. The decayed fruits, often glued together, remain on the tree after the leaves fall. These mummified fruits should be gathered and destroyed, as they spread the disease.

Crown gall is discussed in the section on the almond.



Fig. 10.—Five-year-old Royal apricot tree before and after pruning.

Green rot attacks and rots the young fruits before the calyx husks have been shed. No sure cure is known.

Shot-hole fungus kills the buds in winter; in early summer the fruits are bespeckled with small reddish spots, the leaves perforated with small holes. The trees may be entirely defoliated, and the fruit much disfigured. Bordeaux mixture 5-5-50<sup>10</sup> in the early fall, applied before the rain begins and followed up year by year, is a reliable preventive.

Brown apricot scale, the most important insect of the apricot, occurs singly and in clusters on the twigs and small branches. The insects exude a honeydew on which grows the black smut fungus that discolors the fruit. Spray the trees thoroughly when dormant, from December to February, with 4 per cent commercial oil emulsion (see footnote 7, page 26).

For the Pacific peach borer and the peach-twig borer, see the section on the peach.

*Avocado*.—The avocado, a very tender subtropical fruit, should be planted only in regions of little frost. Outside the southern citrus and subtropical belt it can grow only in those favored spots where lemons are known to thrive. For hot interior valleys or for colder locations the Mexicola, Duke, Benedict, or Ganter varieties are recommended. For cool coastal areas where the ocean breeze is regularly felt, the Anaheim or the Dickinson is suggested. Under favorable climatic conditions the Fuerte is the most popular; but any of the other varieties will also be satisfactory and will provide fruit over a long season.

The avocado thrives on a wide range of soils—that is, from light sandy to heavy adobe. It does best, however, on a medium-textured soil at least 3 feet deep. Being sensitive to poor drainage, it will not endure a water-logged soil. As far as the home planter is concerned, it has few parasitic enemies.

*Blackberry*.—In this discussion the Boysen, Cory Thornless, Himalaya, Logan, Mammoth, Nectar, Phenomenal, and Young as well as the

<sup>10</sup> Formula for making 5-5-50 bordeaux mixture (a winter spray against diseases) :

Bluestone (copper sulfate) . . . . .	10 pounds
Quicklime . . . . .	10 pounds
Water . . . . .	100 gallons

To make 10 gallons of this strength, dissolve 1 pound of bluestone in 5 gallons of water in a wooden or enamel container. (It corrodes metals.) Slake 1 pound of fresh quicklime, and dilute to 5 gallons; or put 1 pound of hydrated lime in 5 gallons. Pour the bluestone and lime solutions together, and stir well. Use immediately. The lime must be fresh.

Several preparations of commercial bordeaux mixture are marketed as a paste or dry powder to be diluted with water. Though the objection is sometimes made that these preparations will not remain in suspension in water so well as the homemade bordeaux mixture, some are probably equal to or better than the average mixture prepared at home. The commercial preparations, though more expensive, are also more convenient; and they are of special value to the small grower.

dewberries will be regarded as blackberry varieties. For convenience they will be divided into two groups—the upright and the trailing types, the latter to include the dewberries.

As a rule the old, upright-growing blackberries are very hardy against cold; but like other bush berries they do not like excessive heat. They do

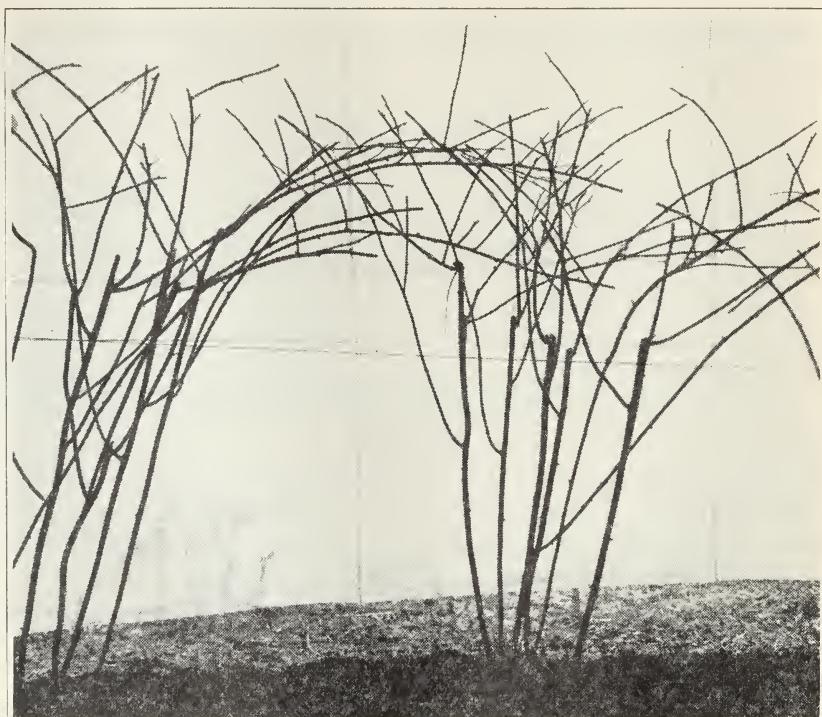


Fig. 11.—Crandall (Macatawa) blackberry after winter pruning; bushes supported by wires, one on either side.

best under coastal conditions and in the mountains. Crandall (Macatawa) is perhaps the best all-round upright variety for southern California; Lawton for the central and northern coast. There is little excuse for planting either of these in the home garden except at high altitudes where others would be winter-killed, for the trailing varieties would be much more satisfactory in every way. The upright-growers may be planted 6 feet apart, and the canes supported by a stake or a two-wire trellis (fig. 11).

Some of the trailing sorts, here treated as blackberries to conform with modern classification, are so different from the old-time blackberries that they have acquired distinct type names. They are all hybrids with a blackberry somewhere in their ancestry. In addition, the Logan, Young,

Boysen, and Nectar have a certain kinship with the raspberries. The dewberry has always been known as a trailing blackberry; and so has the Himalaya, introduced from southern Asia and much publicized by Luther Burbank about 1897. The Logan, a vinelike berry, originated



Fig. 12.—A cluster of Boysen berry fruits. Individual berries may be more than an inch long. (From California Agr. Ext. Cir. 80.)

in California about 1881. The Phenomenal, introduced by Burbank about 1893, is of the Logan type but less acid.

From the Mammoth has arisen a mutant called the Cory Thornless. The Young, a blackberry-dewberry hybrid, became very popular some ten or fifteen years ago, and still dominates many retail markets. Then,

in 1934, came the Boysen similar in type but better in some respects. Four years later the Nectar appeared; whether it will rival the Boysen remains to be seen. Already the different types are developing thornless forms, but no one of them is as yet outstanding.

Cory Thornless, without thorns except when sprouts arise from the roots, is a shy bearer. The Mammoth is also a trailing variety and very vigorous. The plants, therefore, should be set 8 feet apart each way or,

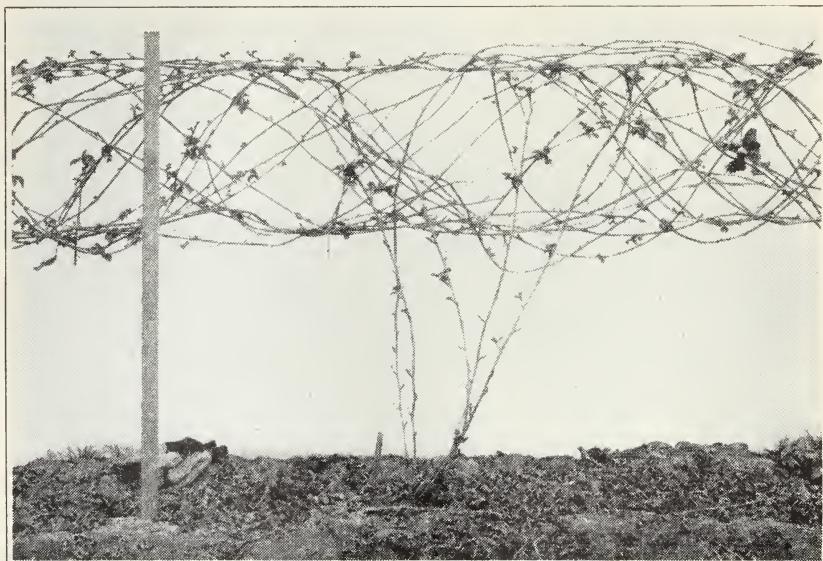


Fig. 13.—Boysen berry pruned and trained upon a two-wire trellis.

if space is available, set 16 feet apart and trained on a trellis. If placed in rows they should be at least 8 feet apart. This rule would serve for the Himalaya as well as the Cory Thornless. Half a dozen plants of either would supply fruit for a family.

The Boysen, Young, and Nectar varieties are so much alike in their growth habits, with the berries so similar in appearance, that they will be included in one discussion. One of these varieties should be in every home berry garden. The berries of all three are 1 to  $1\frac{1}{2}$  inches long and sometimes longer, dark red, tender like a dewberry, and very juicy (fig. 12). Although fairly acid, they are less sour than the Logan. When fully ripe they contain a delicious blend of sugar and acid that makes them excellent fresh or in jellies, jams, and pies. The Young, cultivated for several years and extensively planted in the berry districts along the coast, is now being rapidly supplanted by the more vigorous Boysen.

To the casual observer the Boysen and Young berries look alike; but

there are distinct differences. The Young starts growth in spring considerably earlier than the Boysen, as much as two weeks, and also ripens several days earlier. Although the growth habits of the two are similar (fig. 13), the Boysen is usually more vigorous, and the leaves are a darker green. The fruit spurs that grow in spring from each node on the principal canes average about 2 inches longer on the Boysen than on the Young. These stand out from the vines and facilitate picking.

The Boysen fruit has a distinct aroma which the Young has not. The berries are covered with a dusty bloom, whereas the Young fruits are shiny. There are one or two more berries per cluster than on the Young; they are generally larger and ripen more slowly, but continue long after the Youngs are gone. They have more of a distinct core than the Young. The Boysen and Young yield the same quantity of juice, about 1 gallon to 10 pounds of fruit. Both these and the Nectar are propagated by allowing the tips of the branches to touch the ground and take root. Sprouts are never formed around the old plants. The Nectar, introduced only a year or two ago, resembles the Boysen and the Young but is still on trial. Although of the same type, it is supposed to ripen earlier than either.

Dewberries should be planted at least 6 feet apart each way, and the vines should be trained on a trellis. As a general all-purpose variety the Lucretia is best.

The Himalaya is the most vigorous-growing of all the berries—capable of making a growth of 20–30 feet and even more under favorable conditions in a single season. It is often planted so that it may climb over an arbor or small building or allowed to trail on a fence, for the vines are perennial like a grape and need not be cut back for several years. If planted in rows they should be set 10 feet apart each way and trained on a two-wire trellis. Three or four canes are enough to leave to a hill (fig. 14). The extra sprouts are usually removed as they appear during the summer, for the bearing canes, unlike those of other berries, do not have to be cut back to the ground annually. New shoots are encouraged anywhere in the top where they may be useful for fruiting purposes. Besides thinning out the suckers, which arise from the ground, it may be necessary to do some summer pruning by tipping the pendulous fruiting branches; otherwise, they would soon fill up the space between the rows. The Himalaya yields heavily and ripens over six to eight weeks, usually in July and August, though the period may extend into September. The fruiting canes should be cut out and removed as soon as the yield begins to drop off. Winter pruning will consist in removing any unwanted sprouts that may be left, thinning out the heads, and tipping the new branches that will bear the fruiting wood the following season.

The fruit of the Logan is long, large, dark red, and of high quality. Excellent for canning, it is grown in nearly all berry sections of California. Unless fully ripe the fruit is too acid for some tastes. The canes are vigorous, hardy, and especially productive. They are trailing in habit and covered with numerous small spines. In commercial plantings

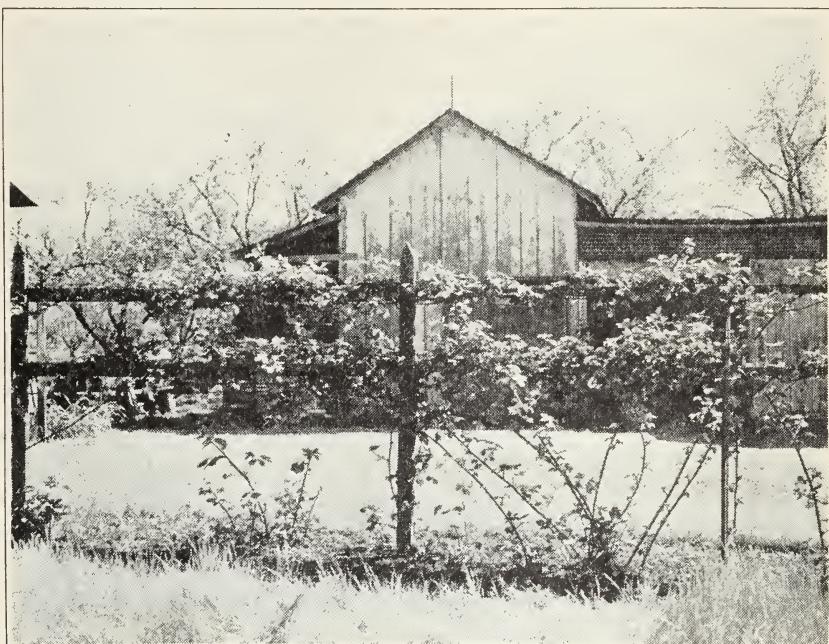


Fig. 14.—Himalaya berries in a back-yard garden. The vinelike canes in this picture are supported by a wooden trellis; but wires are more common. Where there is plenty of room it is permissible to retain many more than the usual number of canes to the hill.

they are often set 6 feet apart with 6 feet between the rows. This spacing crowds them considerably, and to keep up the yields and size of fruit the land must be fertilized. In a home planting it would be better to give them more room. They are usually trained on a two-wire trellis. A thornless form recently developed is very promising. The Logan is propagated by allowing the tips of the vines to touch the ground and take root.

The Mammoth is extremely vigorous and fairly hardy, a rapid grower, and a heavy producer. Under some conditions the flowers appear partially self-sterile and do not always bear well. The canes are not so vine-like as those of the other varieties; they require less room but about the same training. The fruit is very large, long, black, sweet, and soft when fully ripe. It ripens somewhere between early and midseason, usually

between the Logan and the Lawton, and is often sold as a "black Logan." Unless the plants are well cared for, the berries tend to be small; and the plant is subject to injury by the blackberry mite.

As the Nectar variety is much like the Boysen, no separate discussion is necessary.

The Phenomenal variety is strong, vigorous, and productive. The fruit is large, long, red, subacid, larger than the Logan but softer. The drupelets are larger and more irregular. The variety is generally given the same training and culture as the Logan. It ripens about a week later.

The Young so closely resembles the Boysen that one discussion will suffice for both.

**Pruning and training bush berries :** Bush berries may be divided into two classes : those that have a more or less upright habit of growth like the old-fashioned blackberries, red raspberries, currants, and gooseberries; and those that are vinelike, represented by the Logan, Boysen, Nectar, Himalaya, Cory Thornless, Thornless Logan, and dewberry. One principle of pruning holds good with all bush berries except the Himalaya, the Evergreen blackberry, and possibly the Ranere raspberry—namely, that no matter how many sprouts there may be in a hill, only four to seven are left for fruiting, while the others are cut back to the ground.

Because the canes of most berry bushes bear one crop and then die down, they are usually cut out and burned as soon as the crop is harvested. In a few instances they live more than one year and should therefore not be cut out after fruiting. Examples are the Himalaya and Evergreen blackberries, currant, and gooseberry; but even these should be renewed every three to five years. The Ranere raspberry is in a class by itself because it produces two crops a year; the sprouts grow up, flower, and produce some fruit the first season at the ends of the new growth. The new canes, therefore, should not be tipped in the spring as are all the others, nor cut out after fruiting. Winter pruning will be the same as for other varieties, and the following season branches will be formed and will bear a heavy summer crop. All the other varieties require two seasons for completing their fruiting cycle—one for growing the canes or fruiting shoots, the other for producing flowers and fruit.

The first step in the pruning of upright-growing berries (the Ranere raspberry excepted) is to cut off the tips of the growing canes in spring at a height of 18 inches to 2 feet to make them form branches. The second step is to cut out the old bearing canes in July or August. The third (including the Ranere) is to do the main pruning in the winter after the leaves are off. This will consist of cutting out all unwanted canes

and clipping off the tips of the four to seven remaining (fig. 11). The fewest canes should be left where the growth is most luxuriant, for crowding must be avoided. Red raspberries sprout so abundantly from the roots that they are not kept in hills but are allowed to form a hedge.

The first growing season, the trailing varieties are usually allowed to lie on the ground. In winter all but three or four to seven (according to their vigor) are cut out; and the remainder, after being tipped, are trained upon a two-wire trellis. Instead of being tied to the support they are twined around the wires or arranged in up-and-down spirals (fig. 13). The top wire is 4 feet from the ground; the lower one, 2 feet. The trellis is made of no. 14 galvanized wire, though no. 12 would be better for heavy-growing sorts like Himalaya. As the trailing berries are planted only 8 or 10 feet apart in the row, there will be some lapping over when the canes are on the wire; but this is not a serious matter, as the fruiting shoots will push through the mass of vines to the light.

During the early summer, as the fruit is developing, new canes will be sprouting from the roots and sprawling upon the ground. They may be left there or, when long enough, may be wrapped around the lower wire. When the fruit is gone and the old canes are cut out and pulled off the wire, the young ones may be promoted to the upper support. This work is done after the leaves are off.

Himalaya and Evergreen blackberries produce canes that are somewhat like grapevines: they do not die after fruiting, hence are not cut out annually; instead, they are allowed to stand, the tops are thinned out, and the new branches (which carry the fruiting parts) are shortened to stubs 6 to 12 inches long. There will be but three or four of the old canes, since they make a very vigorous growth and more would be unnecessary. They are pruned annually, as above, for three to five years or until they show signs of weakening; then they are cut out and three or four new ones allowed to replace them. As long as not needed, the suckers that continually arise from the roots are cut out twice a year—once in summer and once in winter (fig. 14).

Blue stem, verticilliosis, or wilt, may attack the various kinds of bushberry plants. It stunts or kills the new canes of trailing types like the Boysen and Young. In raspberries all but a small tuft of leaves at the top may fall off. First-year plantings may be severely affected and yet recover the next year. The Young and Boysen berries are very susceptible. The disease enters through the roots, and the canes may wilt rather suddenly or die gradually from the base upward. Diseased plants should be removed and burned. The blackberry and raspberry, particularly the Young and Boysen, should not be planted where potatoes or tomatoes

have been grown for the past several years, as they carry the disease and leave it in the ground.

Cane and leaf spot attacks the Young, Mammoth, Cory, and Logan berries, causing brown or grayish spots on the canes and small dead spots with brown or reddish borders on the leaves. Diseased plants may have to be dug out after the second season. The disease can usually be controlled by removing and burning all diseased canes immediately after harvesting the crop.

The orange rust of blackberries and the leaf rust of raspberries are kept under reasonable control by cutting out and burning the diseased canes each summer at the close of the fruiting period, particularly if all leaves under the plants are raked up and burned in early winter.

The blackberry mite is a tiny pest that attacks principally the Himalaya, Cory Thornless, Mammoth, Evergreen, and Crandall blackberries and prevents their ripening. The berries reach approximately full size but always remain hard, red, and immature. As the buds are opening in spring, spray with 4 to 8 gallons of lime-sulfur solution to 100 gallons of water.<sup>11</sup>

The raspberry horntail is a worm that girdles the tips of tender new shoots especially of the Logan and Himalaya berries, and causes them to wilt. It may work up or down the cane to a considerable distance. The remedy is to cut off the canes several inches below the point where the wilt shows and to burn the prunings.

*Blueberry and Huckleberry*.—These should be planted only in the cool coastal region. The huckleberry grows wild among the redwoods. Both these berries prefer an acid soil such as is found in cool, shady locations. Naturally they grow where there is much decaying vegetation. The High-bush blueberry of the East might do well under conditions favorable to the huckleberry. The Pioneer is a good average variety. None should be considered in southern California or in the interior valleys. For pruning, see the section on the blackberry.

*Cherry*.—Though the sweet cherry is the type chiefly grown in the orchards of California, the sour cherry of the East would perhaps be more satisfactory in the home garden. The latter will set fruit from its own pollen, whereas the sweet cherry must be cross-pollinated and therefore at least two trees are involved. Birds are very fond of sweet cherries;

<sup>11</sup> Formula for mixing lime-sulfur (a dormant spray for scale insects and some diseases) :

Liquid lime-sulfur .....	8 gallons
Water to make .....	100 gallons
or	
Dry lime-sulfur .....	16 pounds
Water .....	100 gallons

and if there are only one or two trees in the home garden, the owner may get none of the fruit.

Cherries do best near the coast and in the coastal valleys, less well where the climate is warmer. The tree fails in the Imperial Valley but thrives in much of the foothill country. In the south, sweet cherries will do well up to 3,000 to 4,000 feet; but they do not flourish in any of the valleys, for the winters are too mild. Sour cherries do moderately well in many of the valleys and are hardy at elevations up to 5,000 feet.

Sweet cherries are borne mostly on long-lived spurs which are economically productive for ten to twelve years. After the trees come into bearing, they require little pruning. About all that is necessary is to thin out the new shoots lightly each year and to cut out all weak and interfering branches. Because of the upright habit of growth, the pruning should be such as to spread the tree as much as possible. New shoots coming out low down should be encouraged, and the tops kept from getting too high by an occasional cutting back to strong laterals. The desirable amount of new growth is about the same as for apples and pears (fig. 15.)

The Royal Ann (Napoleon), a white cherry, and the Black Tartarian are two of the best sorts for the coastal region. Bing and Lambert, both black, are other good varieties. Black Tartarian will pollinate Royal Ann, Bing, and Lambert and is itself pollinated by them. Although usually first to ripen, it is followed closely by Bing and Royal Ann. Lambert is late. One tree of Montmorency, a sour cherry, will furnish pies for the family in season and enough fruit to fill several jars for canning.

Armillaria, or oak-root fungus, is discussed in the section on the almond.

Brown rot attacks the blossoms, the spurs, and sometimes the fruit, but is generally not serious on isolated trees. The remedy is bordeaux 5-5-50 to 8-8-50 (see footnote 10, page 33), applied in spring as the first flower buds are opening.

For a discussion of symptoms and remedial measures in bacterial gummosis, see the section on apricot. Black Tartarian and Royal Ann varieties are the most susceptible, followed by Bing and Lambert. The Lambert is seldom injured. Pie cherries are highly resistant. Trees growing in alfalfa are likely to be free from the disease.

Crinkle leaf, a relatively new disease, causes the leaves of bearing trees to curl partially, as though wilted. If the trees decline in vigor they should be removed, and something else planted, for no remedy is known. Black Tartarian seems to be the most susceptible variety.

Black cherry aphids and slugs, the most prevalent insects of the

cherry, appear in spring and early summer. The former cause severe curling of the leaves, while the latter eat away the epidermis and thus skeletonize the leaves. Spray with nico-soap solution made by using 1



Fig. 15.—Typical Black Tartarian cherry tree seventeen years old.  
(From California Agr. Ext. Cir. 46.)

teaspoonful of nicotine sulfate (such as Black Leaf 40) and 2 tablespoonsfuls of whale-oil soap to 1 gallon of water (see footnote 7, page 26).

*Chestnut.*—Though the chestnut would probably grow anywhere in

the state, it does best in a cool climate. Both the American and French types make large trees. While a single tree will produce a good many nuts, it is best to plant two varieties to provide cross-pollination. For a large tree, plant a Marron Combale or an American Sweet, and a Marron Quercy, as they will pollinate each other. The Japanese chestnut, if obtainable, makes a much smaller tree; but the nuts are inferior to the French. Parry, a Japanese hybrid, is probably the best for California. Italian seedling chestnuts are rather widely grown in the state, the nuts selling readily in the local markets.

*Cranberry*.—Cranberries grow in peaty bogs near the ocean. In California fairly good natural conditions exist in a few places in Mendocino and Humboldt counties. The peat bog should be situated near a good deposit of sand, and there should be an abundant water supply because the bog must be flooded in spring, summer, and autumn to control insects. Before planting, the bog should be made level and covered with clean sand to a depth of 3 or 4 inches. Cranberries are propagated from cuttings, which are set in the sand 12 inches each way. Planting may be done from March to June. The McFarlin and Howes varieties have done best in Oregon.<sup>12</sup>

*Currant*.—Currants do not thrive outside of coastal conditions or low mountains nor anywhere in the south, though a few bushes may be planted where they are partially shaded. Plant them 3 feet apart each way. Only the red currant is planted in California, the Perfection being the best variety. Pruning consists of removing the three- and four-year-old wood and in thinning out the new shoots when they are too numerous. Ordinarily from three to five old stalks are removed each year, and an equal number of young ones left to replace them.

*Date*.—With only slight injury the date palm can stand a temperature as low as 15 degrees Fahrenheit, but the fruit will not ripen where there are early autumn frosts. For proper ripening the season must be long and the summer warm. The date ripens satisfactorily only in a very few spots outside the hot desert valleys of the southeastern part of the state. Given a satisfactory climate, the greatest danger is injury from rain after the fruit is two-thirds ripe. From the standpoint of production, the date palm reaches perfection only in the Coachella and Imperial valleys of Riverside and Imperial counties.

The Khadrawy and Halaway varieties are recommended: the former appears adapted to a rather wide range of conditions, while the latter ripens early and is little damaged by humidity or by occasional rains.

<sup>12</sup> Brown, W. S. The cranberry in Oregon. Oregon Agr. Exp. Sta. Bul. 225:1-31. 1927.

For pollination it is necessary to have two trees—one with male and the other with female flowers; the latter produce the fruit. In securing trees one should keep this fact in mind. In growing dates from seed it is impossible to tell which are male and which are female until they have reached fruiting age—after five or six years or more. The pollen from



Fig. 16.—Cluster of fruit of the strawberry guava, used for jams and jellies and for eating out of hand. Climatic requirements are about the same as for the orange.

the male tree must be dusted on the female flower cluster by hand. Since only highly specialized nurserymen in date regions handle the trees, some amateurs may desire to grow them from seed. In any lot of seedlings there will be a good preponderance of males. The date of commerce is propagated from suckers that arise from the base of the trees. These may be carefully cut away, rooted, and planted.

*Feijoa and Guava.*—Although classified botanically as belonging to

different genera of the myrtle family, the feijoa and guava are similar in many respects. The plants are shrubs of considerable ornamental value, reaching a height of 15 feet or more, though they can be kept lower by training. They produce fruit often considered unexcelled for



Fig. 17.—Mission fig; a desirable tree about any home for both fruit and shade.

jam and jelly making or excellent for eating out of hand. The feijoa is unique in that its large fleshy petals are edible. The flower may be  $1\frac{1}{2}$  inches in diameter. There is a considerable difference in hardiness of the various species. The feijoa, commonly known as pineapple guava, is the hardiest of all and will grow satisfactorily in most parts of the state,

withstanding temperatures of 15 degrees Fahrenheit with little damage. The strawberry guava, an excellent all-purpose fruit, can be produced successfully wherever oranges are raised (fig. 16). The lemon guava, being tender, can be grown only in the most protected places and is not recommended for the general home garden.

*Fig.*—The fig, a deciduous subtropical tree, can withstand a temperature of 15 degrees Fahrenheit and is successfully grown at altitudes up to 3,000 feet. Very young trees may be injured by frosts of early fall or late spring. Only two or three varieties of figs are really suitable for the home garden in most parts of the state: the black or Mission, which grows all over California but is at home chiefly in the central and northern valleys; and the Kadota, mostly used for canning and especially adapted to the San Joaquin Valley, where it is dried as well as canned. The Kadota is not recommended for Los Angeles County. The Mission is desirable about any home: not only does it make a fine shade, but a single tree, well grown, will produce an abundance of fruit (fig. 17). In central California the first crop ripens in June; the second in August and September. The trees will require practically no care. The large white figs of commerce, chiefly the Calimyrna, are of the Smyrna or Asiatic type, and are not recommended for home planting because of pollination difficulties. They can be pollinated only if provided with a supply of fig wasps. The procedure is to place young wild caprifigs containing these insects in cans that are tied to a branch inside the Calimyrna tree; the wasps, having crawled out with pollen clinging to their bodies, enter the blossom end of the Calimyrna and bring about fertilization. The caprifigs have no value except to harbor the fig wasp until it is needed. The Mission fig, on the other hand, is easy to grow; it does not require artificial pollination and needs only ordinary attention otherwise. In the San Joaquin Valley the White Adriatic fig is extensively raised for drying, but even there the Black Mission would probably be more satisfactory as a back-yard tree. In Los Angeles County the Turkey (Brown Turkey) is the principal fresh fig, both for dooryards and for the fresh-fruit market.

*Filbert.*—This form of hazelnut does not, as a rule, produce well in California. It bears best in the foothills, second best along the coast, and only rarely in the interior valleys. It is not recommended for southern California. Two varieties must be planted to insure cross-pollination. The Barcelona, Du Chilly, and White Aveline are the most promising. Filberts are bushes that grow to 8 or 10 feet. Though they can be trained to a single trunk, they are usually allowed to sucker from the base and form dense clumps (fig. 18). Plant them 20 feet apart each way.

*Gooseberry*.—The gooseberry does best along the coast, particularly around San Francisco Bay. It may be grown in a small way in shaded places in the interior, but in southern California it is wholly unsatisfactory.



Fig. 18.—Filbert, variety Barcelona, aged seven years; trained in the form of a dense clump.

factory. Mildew, the worst disease, can usually be controlled by cutting out and burning the affected parts; all dead leaves should be raked and burned. One spraying with lime-sulfur 1-10 just before growth begins in spring will usually prevent mildew. The Houghton, a heavy producer,

is perhaps the best all-purpose gooseberry. The berries are small, roundish, dull red when fully ripe. It is earlier than the Downing, another good variety, but is less resistant to mildew. The plants should be set 3 to 4 feet apart in rows 4 feet wide. For pruning, see the section on currants.

*Grape*.—The owner of a home garden usually prefers to grow grapes for the table only, not for drying or wine making. Grapes are produced

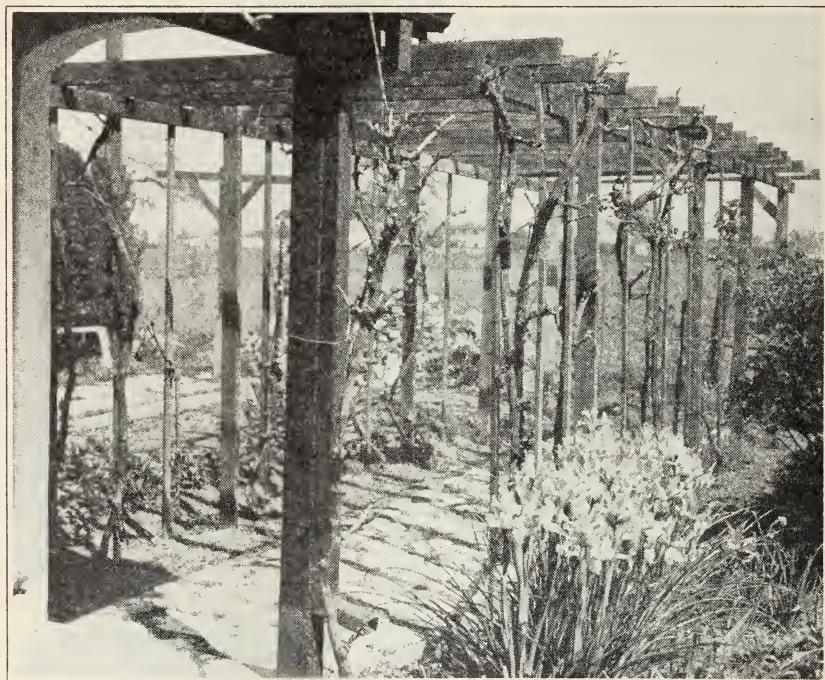


Fig. 19.—Grape-covered arbor.

in all counties of the state; but in cold, foggy situations along the coast and in the high mountains (above 3,000 feet) they do not ripen well. This is particularly true of eating varieties of the European grapes.

After the home garden is filled with trees, berry bushes, and the like, a few grapevines may still be trained on a fence, against the sunny side of a building, or on an arbor or pergola (fig. 19). Most of the grapes grown in California belong to the European or *vinifera* type, which are most at home in the warm valleys. Near the coast and for mountain plantings, the hardy eastern varieties would be more satisfactory.

A good selection of table grapes for interior California would be Ribier, Red Malaga (Molinera), Olivette Blanche, Flame Tokay, Thomp-

son Seedless, Muscat of Alexandria, and Emperor. Ribier is a black grape with very large berries. The clusters are usually medium-sized. Imported from France by the California Experiment Station in 1904, it is a valuable addition to our varieties. The Red Malaga has large, deep-red berries. It can be produced in the hot valleys where the Flame Tokay does not attain good color. Flame Tokay can be grown to advantage in the foothill areas and in the cooler intermediate valley around Lodi. The Olivette Blanche variety, sometimes known as Lady Finger, has white, elongated berries, very pleasant for eating. Thompson Seedless (Sultanina) seems to suit all tastes. The clusters are large; the berries medium to small, white with a yellowish tinge, sweet but sprightly subacid. The Muscat, an old-time favorite, has large berries that are white, juicy, aromatic, and very sweet. The Emperor is mentioned because it is a very late variety, suitable for the interior valleys and for southern California. The clusters and berries are large, dark red to reddish purple, and firm. As the variety keeps well when stored, it is extensively shipped to the eastern states for the Christmas trade.

For moderately cool locations outside the fog belt the varieties Pearl or Csaba and Chasselas doré are recommended. Both are white grapes of good eating quality. For the coastal region inside the fog belt and also for the mountains, four eastern varieties—Concord, Pierce (California Concord), Iona, and Niagara—will serve very well. The Concord, a black grape, is the most widely grown variety in the East. The Pierce resembles the Concord but does better in warm places. The Iona is a red, the Niagara a white grape. Eastern grapes are sometimes designated as slip-skin because the skin parts readily from the flesh and may be discarded along with the seeds.

For southern California the Concord and Pierce are recommended for coastal locations; the Concord, Pierce, Ribier, Golden Muscat, and Malaga for the intermediate climatic districts of the semicoastal valleys; and the same list, plus Thompson Seedless, for the warm interior valleys.

Grapes must be severely pruned annually. When young the vines are trained, usually to a single trunk extending as high as the permanent parts are to go. At the top of the trunk are developed two, three, or four short, permanent branches extending in the desired directions. Each winter most of the current season's growth is removed, leaving one or more short spurs or fruiting canes on each arm (fig. 20). If the current season's growth is small and weak, less fruiting wood should be retained than was left the previous year. If the growth has been vigorous, more may be retained. If the variety produces fruitful shoots from buds near the base of the canes, only spurs, usually two or three buds in length,

are left. Muscat, Ribier, Red Malaga, Tokay, and most wine grapes are of this type. The Thompson Seedless, Olivette Blanche, and most eastern varieties—Concord, Iona, Niagara—require long canes instead of spurs to produce good crops. These canes are basal portions of current season's



Fig. 20.—Grapevine trained to a stake until old enough to stand without support. The annual pruning consists of reducing the new growth to a series of spurs, one or more to each arm. This is the usual method of pruning and training most varieties of *vinifera* grapes.

growth, from 2 to 5 feet long. The old fruit cane that has borne a crop must be removed each winter, and a new one left in its place. Usually not more than three or four canes are needed on each vine (fig. 21).

Vines of varieties that bear good crops with spur pruning may be developed in the form of low, self-supporting shrubs (fig. 20). They may also be used on a fence or arbor. Those requiring long fruit canes require a trellis or an arbor on which the canes may be tied for support (figs. 19 and 21).

Grapes planted in deep soils usually need two or three irrigations each season. On very shallow soils water may be applied as often as every two weeks.

The worst common pests of the grape are mildew, leafhopper, and phylloxera. Mildew, the worst disease, is widely distributed throughout the grape-growing regions of California. It attacks all green parts such

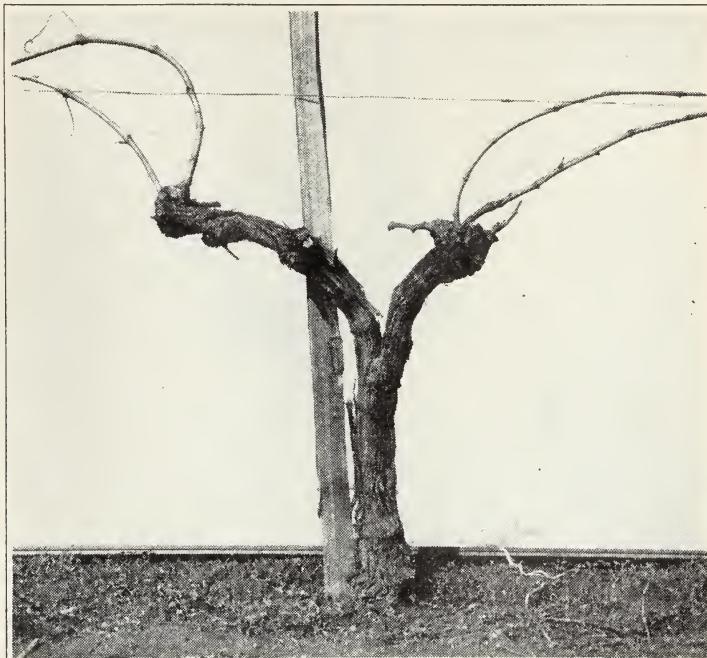


Fig. 21.—Trellis-trained grape. Thompson Seedless, Olivette Blanche, and all Eastern varieties require long canes instead of spurs to produce crops. These are supported by a one- or two-wire trellis.

as the leaves, shoots, and unripe grapes. If neglected, it causes curling and withering of the leaves in the spring, dropping and discoloration of the berries, and blackening and imperfect maturing of the canes. It is controlled by dusting with very finely divided sulfur. Dust the vines four times—first when the shoots are 6 to 8 inches long, second when they are 15 to 18 inches, third just before blossoming, and fourth when the grapes are about one fourth to one third grown. Along the coast one or two additional dustings may be necessary. The grape leafhopper or "vine hopper," which attacks the leaves, is the worst insect pest in the hot interior valleys. Apply a pyrethrum oil spray when the shoots are 3 to 6 inches long, and follow with one or two applications of

a nicotine or pyrethrum spray or nicotine dust when the greenish nymphs, about  $\frac{1}{10}$  inch long, are found on the undersides of the leaves. Phylloxera, a plant louse, harms only the roots. There is no remedy except to use a resistant stock like the Rupestris St. George.

*Grapefruit*.—Grapefruit, or pomelo, has about the same climatic requirements as the Valencia orange, but only in citrus areas of very high heat does it achieve superb quality. Its cultural needs also resemble those of the orange. If but one tree can be planted, the Marsh variety would be best.

*Guava*.—The guava is discussed in the section on the feijoa.

*Huckleberry*.—For discussion of the huckleberry, see the section on the blueberry.

*Jujube*.—This Chinese fruit was introduced, several years ago, by the United States Department of Agriculture. The tree is deciduous and, under favorable conditions, reaches 20 to 25 feet. It is well adapted to regions of severe winter frosts. It thrives best in the warm interior valleys of the central and northern parts of the state but is not valued or often recommended for southern California. The tree begins bearing the first or second year after planting. It yields great quantities of small, dark-brown shiny fruits from 1 to 2 inches long, usually oval but sometimes round, as much as 2 inches in diameter. When eaten fresh from the tree, just as the skin is turning brown, the fruit is sweet and crisp. It is also made into a jam, but most often into candied fruit. The trees are ornamental and go well with the lawn shrubbery. Two good varieties are the Lang and the Li; the former is pear-shaped, the latter round.

*Lemon*.—Outside the proved citrus regions it is hazardous to plant the lemon. One may, however, grow single trees in doubtful locations by giving them the protection afforded by the south side of a house or other large building. Though an established tree will not be killed by a light frost, the fruit crop may be destroyed, for there is rarely a time when the tree does not contain either flowers or fruit. The Lisbon, being hardy, resistant to disease, and generally vigorous, is perhaps best for home planting, although the Eureka and Villa Franca are both popular. The best variety for cold locations is the Meyer, which is readily propagated from cuttings; it may be injured but is not killed by 10 to 15 degrees of freezing. It makes a tree 6 to 10 feet high (fig. 22).

*Lime*.—The lime, the most tender of all citrus fruits, should be planted in regions of almost frostless winters. It requires about the same attention as other citrus trees. (See the section on the orange). The Bearss and Mexican varieties are suggested.

*Loquat*.—The loquat, an evergreen, under favorable growing conditions makes a tree 30 to 40 feet high. In the interior valleys it may be only one third as large. Hardier than most subtropical trees, it thrives almost anywhere in California except in the mountain and desert regions, but does best near the coast. Unfortunately it is attacked by pear blight in warm locations; affected branches should be cut out at once, and the wounds disinfected. The fruits are usually sweet and rich,

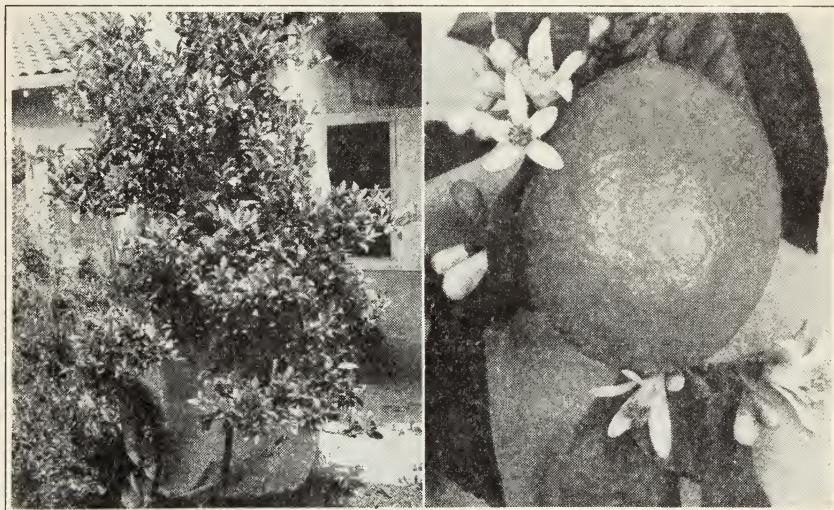


Fig. 22.—Meyer lemon tree fourteen years old growing on the south side of a residence in Davis. When seven years old this tree survived a temperature of 12 degrees Fahrenheit, although it was killed almost to the ground. There were twelve dozen lemons on the tree at the time of the freeze. To the right, fruit and flowers of the Meyer.

with a sprightly aromatic flavor, and make fine jellies. The loquat ripens in early spring when other fruits are scarce. The variety Champagne is rather acid; the Thales much sweeter. The first does best in the interior; the latter on the coast.

*Nectarine*.—For all practical purposes the nectarine is a smooth-skinned peach. The flavor, though often distinctive, is also reminiscent of the peach. Peach and nectarine trees differ in no essential respect from each other in appearance, growth responses, or bearing habits. While the skin of the peach may be fuzzy or even only slightly pubescent, the nectarine is as smooth as a plum, and its flesh has a more pronounced aroma and a richer flavor than that of the peach. Both peaches and nectarines may be either clingstone or free; and the flesh may be red, yellow, or white.

The nectarine is one of the most interesting fruits in horticulture.

Nectarines have been grown from peach seeds, and peaches from nectarine seeds; peach trees have produced nectarines by bud sports, and nectarine trees, peaches. Trees have borne individual fruits that were half peach and half nectarine. If only one variety can be planted, it should be the John Rivers or Gower. If two, add Gold Mine; and if three,



Fig. 23.—A bearing Ascolano olive, not so desirable as the Mission or the Manzanillo, but of attractive appearance.

include Victoria. Where there is too little cold weather to break the rest period thoroughly, Diamond Jubilee will give best results. For further discussion, see the section on peaches.

*Olive*.—The olive, an evergreen tree, is hardy enough and adaptable enough to be grown in all parts of the state except near the coast and in the mountains where there is a severe winter climate. Although it will survive great neglect, it responds to irrigation, pruning, and spraying. It is perhaps the longest-lived of all of our fruit trees. Having great ornamental value, it deserves a place in the home garden for that purpose alone (fig. 23). In planting, cut back and shape the tree in much

the manner described for deciduous trees. Little pruning will be necessary except further shaping during the first two years. Afterward an occasional branch may have to be removed to keep the head from becoming too dense. The Mission and Manzanillo are leading varieties, the fruit of the first being rather small and abundant, the second having larger fruit but usually a light yield. The Mission makes a much larger tree than the Manzanillo.

Black scale may be serious under coastal conditions but seldom occurs in the interior. The insects attack chiefly the twigs. Spray with 4 per cent commercial oil emulsion (see footnote 7, page 26), from December to February. Some control may be obtained by thinning out many of the affected branches in late winter.

*Orange.*—Though the orange is a subtropical fruit, mature trees will stand several degrees of freezing. In doubtful locations it should be protected during its first two or three winters. Older trees need not be protected; they will stand more cold than young ones, and it is impractical to try to cover their tops. Sweet-orange seedling trees or, preferably, budded trees of such varieties as Jaffa, Malta, Ruby, and Pineapple seem hardier than the best market varieties; and the fruit, when fully ripe, is excellent for home use, though it drops very soon after ripening in spring or early summer. Besides being useful, such trees are ornamental as long as the fruit lasts (fig. 24). Sour-orange trees also have considerable ornamental value because the fruit, being inedible, lasts a long time.

Budded varieties can be grown not only in all the counties south of the Tehachapi Mountains but throughout most of the great interior valleys and the adjacent foothills. Although the northern coast region is ill-adapted to oranges, trees can be grown there in sheltered places in the valleys with a fair degree of success.

Trees should be purchased with the roots enclosed in a ball of earth. They should be planted early in March just as growth is beginning. Although they will grow on a wide variety of soils, good drainage must be provided. If the subsoil is hard, cultivation should be very shallow, and water should be applied frequently but sparingly. Blasting for hardpan is usually not beneficial to citrus. Trees should be set no deeper than in the nursery; deep planting would be fatal. Open up a large hole somewhat deeper than the tree requires; throw in a few shovelfuls of top earth in the bottom, until the tree stands at the proper level; and then deposit soil evenly around the ball, ramming it down with a board if necessary, until the hole is half filled. Then go around and around the tree, adding soil and tramping it down. Wet down after planting, in

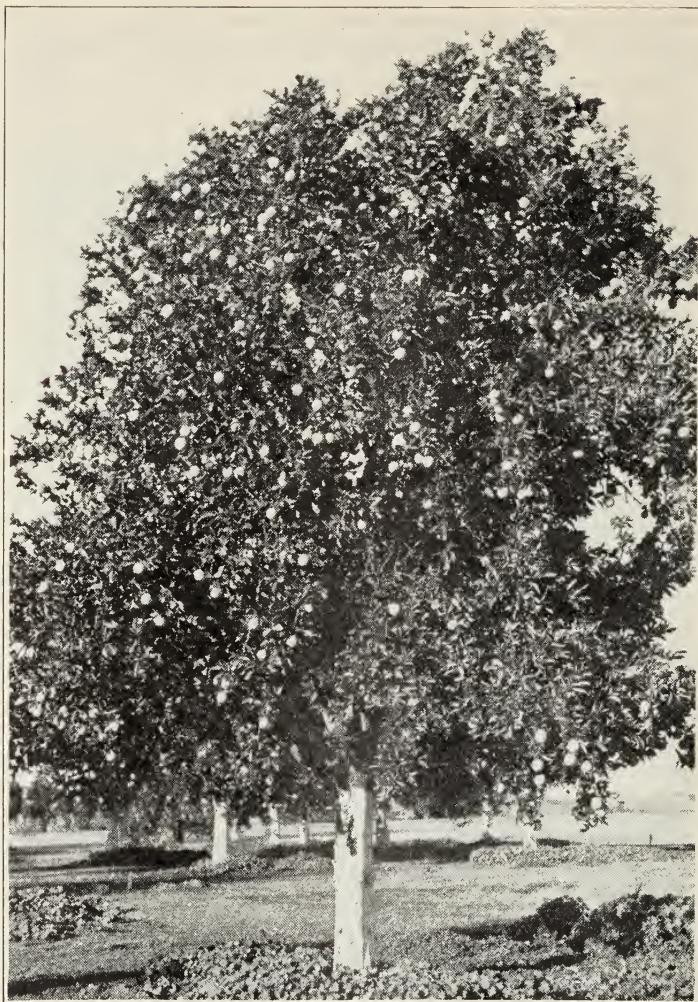


Fig. 24.—A very old and highly ornamental seedling orange tree in the Wolfskill Experimental Orchard near Winters (now owned by the University of California). The orange is highly desirable for the home planting, both for its fruit and for its ornamental value. Sweet-orange seedlings, being apparently hardier than the best market varieties, are suitable for cold locations. In the south there would be little excuse for planting seedlings.

order to settle the soil. Spread a layer of loose earth over the top. The burlap covering is seldom cut away before filling in the soil. If it is old and already decaying this will not be necessary. The wrapping cord, however, should be severed, and the burlap folded back after the water has been applied and the tree and ball have settled into place and before the top 2 or 3 inches of soil have been filled in. Thus the ball itself is never left unprotected until the dirt is settled in around it by soaking.

The tree, when received, will already be headed at about the right height. The top may require some thinning, but not much. The object of any subsequent pruning will be to prevent the head from becoming so dense that the interior will die from overshading. Outside of citrus districts, where groves are not numerous, insect pests are usually not plentiful or serious. The home owner in the interior valleys, with only one to half-a-dozen trees, may never need to spray or fumigate. This is fortunate because the necessary equipment is expensive. In lower coastal and intermediate districts, pests may make it inadvisable to grow citrus unless they can be combated.

Orange trees should never be allowed to suffer from lack of water. A single tree may be surrounded by a levee that extends a little farther out than the tips of the branches and can be filled with water. When using this type of basin irrigation, one must plant the trees high; then a bank can be carried out from the trunk for 2 or 2½ feet so that the water in the basin will never get to the trunk. The number of irrigations will depend upon the climate. In the Sacramento and San Joaquin valleys, bearing trees will need water every 2 or 3 weeks. Younger trees may require even more frequent applications; they must be observed closely and watered whenever the ground seems to be dry down to a depth sufficient to involve the roots. Water them as often as necessary to keep them growing, but not so often as to keep the soil continuously wet. The ball of earth surrounding the roots of young trees is usually of rather heavy soil. Planting them in light soil gives rise to watering difficulties. Water must be held around the ball for a long time so that it will not drain away through the light soil before the ball is wetted.

There are two types of market oranges, as determined by their season of ripening: the Valencia, which ripens in the summer; and the Washington Navel, a seedless variety, which ripens in winter. If possible, both types should be planted. Where the trees are planted in rows, they should be given ample room—that is, 20 to 25 feet in each direction.

*Passion Fruit.*—The edible passion fruit grows well in California and safely withstands frosts and even very light freezes. If planted on the

south side of a building it will endure several degrees of freezing without the roots' being killed. The vines, woody perennials, grow very rapidly and in two seasons will cover the side of a large residence. The



Fig. 25.—Purple passion fruit (*Passiflora edulis*). The flavor is delicious, and the flowers are unique and attractive.

fruit (fig. 25) is 2 to 2½ inches long and slightly oval; it has many uses. Inside the leathery rind are numerous small seeds, each surrounded by a yellowish, aromatic, juicy pulp of distinctive and pleasing acid flavor. The pulp may be eaten out of hand or used in fruit salads. The juice, if

extracted, will serve as a beverage or may be used in various cocktails, cordials, jellies, sherbets, ice creams, icings, candies, and cakes.

*Peach.*—As compared with other deciduous fruit trees, the peach is relatively short-lived. If, however, wood decay is kept out, the tree may be depended upon to live for at least twenty-five years. It comes into bearing when three to five years old. It reaches its peak of production at nine to twelve years and may decline rather rapidly if large branches are cut or broken off and the wounds unprotected so that wood-decaying organisms gain an entrance. Although hardy anywhere in the state, it is not recommended for the mountains because of its early blooming habit in spring. Having a distinct rest period, it requires some cold weather in winter. An exception to this rule is a new variety called the Babcock.

The peach likes a deep, well-drained soil, which must be free from alkali. It will thrive on soils more sandy than the ideal but will then need more frequent irrigations, together with manure or some other nitrogenous fertilizer. The trees should be given a good watering three or four times during the season from spring to fall. The worst pests are leaf curl, California peach blight, and the twig borer, which burrows into the twigs and may seriously infest the fruit.

As the peach bears practically all its fruit on one-year wood, one must usually prune peach trees more heavily than others in order to induce sufficient growth. The desirable amount of new growth as a whole over the bearing tree is somewhere between 12 and 30 inches annually. Besides thinning out entire new shoots wherever necessary, one should cut back the remaining shoots lightly or moderately to a strong lateral, and thin out the remaining laterals. The number of shoots saved will depend upon several considerations—for example, the total leaf surface resulting from light or heavy pruning, and the probable water supply (fig. 26). If the tree is off the lawn one should save as many hanging shoots as possible, for these are very desirable for fruit bearing. The early training of the tree is discussed under "Pruning," in an earlier section.

Varieties in the home orchard should consist of early-, medium-, and late-ripening sorts, preferably freestones of the highest eating quality for their season. Mayflower and Alexander have white flesh and ripen the first week in June, but they are not freestones. Briggs, also white-fleshed, but a semicling, ripens the middle of June. Triumph and Hale Early, one yellow and the other white, but both free, ripen the last week in June. The St. John, a yellow-fleshed freestone, ripens the second week in July. The Late Crawford, yellow and free, ripens about August 1; the Lovell, yellow and free, August 20; and the Salwey, yellow and

free, about the beginning of the second week in September. For quality the Hale Early, St. John, J. H. Hale, and Late Crawford are the best. The Babcock, a white-fleshed freestone, is mentioned because it has practically no rest period and can grow where others will languish and



Fig. 26.—A well-shaped dooryard peach tree after pruning. Because it is used as a lawn shade tree, hanging branches have been discouraged; they would be in the way.

die. The ripening date is about the first of July. The quality as compared with others is rather poor. Varieties for the warmer portions of southern California include Babcock, C. O. Smith, Luken's Honey, and Early Imperial. Other varieties resistant to delayed foliation have been developed and may be ready for distribution in the next few years.

The high mountain valleys of the south can grow all of the varieties that have been mentioned. For additional kinds see tabulated lists on pages 80 and 81.

*Armillaria* or oak-root fungus may attack peach trees; for discussion of this fungus see the section on the almond.

Peach-leaf curl appears in spring as red, crinkled, thickened distortions on the leaves and green shoots. A white mold that occurs on affected parts is really the spores or fruiting bodies of the fungus. Later the fruit may develop red, warty protuberances that will render it unusable. If the disease is bad the tree may be defoliated. Though another crop of leaves will develop, the trees have been considerably weakened. If untreated for two or three seasons they may be killed. This is the worst disease of the peach. Control consists in covering the trees thoroughly with bordeaux mixture 5-5-50 (see footnote 10, page 33) before the fruit buds begin to swell in the spring. If the disease has been bad, the first application may be made as early as January, and a second one just as growth starts.

Peach blight appears first in early winter as small, circular, reddish spots on the twigs. Later these spots develop into elongated, sunken, brown cankers that kill the fruiting wood. When the leaves appear they too, may be attacked, and when rains occur late in the spring the fruit is also affected. In severe leaf infection, the trees are defoliated and therefore badly weakened. Spray in the fall (November 15-December 15) with bordeaux mixture 5-5-50 (see footnote 10, page 33).

The Pacific peach tree borer in the larval stage burrows into the base of the trunk and into the main roots, often girdling a tree and killing it. Gum and excretions indicate the presence of the borer. It may be controlled by spreading a double handful of the crystals of paradi-chlorobenzene around the base of the tree but not in contact with the trunk. Cover the crystals with soil by mounding up to a height of 6 inches, as some of the borers work a few inches aboveground. As the crystals vaporize, the heavy gas penetrates the soil and the burrows, killing the insects. Apply the material in late summer and fall (preferably in October) when the soil is warm and the moisture not excessive.

The peach twig borer, a reddish-brown caterpillar about  $\frac{1}{2}$  inch long, burrows into and kills the buds and twigs, sometimes seriously infesting the fruit. The worms, having hibernated just beneath the outer bark of the crotches of the framework and smaller branches of the tree, emerge in the early spring to infest buds and new shoots. Spray with

basic arsenate of lead<sup>13</sup> when at least two thirds of the blossoms have fallen and again early in May if wilted twigs, caused by a second brood of the insect, are noted.

*Pear.*—The pear is not recommended for home planting in the Sacramento and San Joaquin valleys because it is too much trouble to protect the trees from fire blight and codling moth. Along the coast and in the coastal valleys, as a rule, only the codling moth need be combated. Although pears may require cross-pollination, there will usually be enough scattered trees in any locality so that the bees will carry the necessary pollen from place to place.

The pear yields most of its crop on long-lived spurs, the economic productive life of which is seven to eight years. The fruit is produced from a terminal bud one season; the next season the spur elongates a little and sets another terminal fruit bud; and the following season fruit is again produced. Pears tend to be alternate bearers, although this tendency is less marked in California than in the East. The pruning should consist mainly in a judicious thinning out of the new shoots, with the occasional removal of a larger limb. Where blight is a serious consideration, the main limbs should be kept free from fruit spurs to prevent the entrance of the disease, which generally begins in the flowers. The succulent growth that follows the heavy heading often given pear trees is much more susceptible to fire blight than are the short, firm shoots that follow a thinning-out process. A new growth of 6 to 10 inches each year is all that is needed (fig. 27).

Bartlett is the leading variety in the state for all purposes. On the coast the Comice and Hardy do well. The Winter Nelis, though less high in quality than the Bartlett, is also less subject to blight. The fruit of the Seckel is small but of highest quality, and is not susceptible to blight. All pear varieties are susceptible to delayed foliation; none do well in the warm valleys of southern California, and pear growing there should be confined to elevations of 2,000 feet or higher.

The black end of pears is really not a disease, for no parasite is involved. It is caused by growing the trees on Japanese pear roots. As the name would indicate, when the pears are nearly grown an area at the blossom end blackens, becomes hard, and may crack open. The remedy is to plant trees on French pear or quince roots.

Fire blight is the worst disease of the pear in all warm districts of the

<sup>13</sup> Formula for basic lead arsenate (for biting insects):

Basic lead arsenate (powder) .....	3 to 4 pounds
Water .....	100 gallons

To wet the foliage effectively, a spreader—for example, casein or blood albumin—should be used as recommended by the manufacturer.

state. It is seldom severe where the coastal influence is strong. In the interior valleys it is so difficult to handle that the home owner is advised not to try to grow pears there. Fire blight is a bacterial disease



Fig. 27.—Bartlett pear about twenty-five years old, in Lake County.

that enters mostly through the flowers. It appears in spring just after blossoming and spreads rapidly into all parts of the trees, reaching even the roots. The only remedy is to cut out the affected twigs or branches well below the signs of the disease and to disinfect with bichloride of



Fig. 28.—Seedling pecan twenty-three years old on the University Farm, Davis. The tree, being too large for the yard or garden, is better suited to country homes. It bears heavily in the interior valleys; but the nuts are small and usually hard-shelled. Note the many immature nuts still hanging on after the leaves have fallen. Pecan trees are likely to continue growing until overtaken by frost.

mercury or cyanide of mercury. Spraying is ineffective. Blight on large branches may be treated by carefully shaving off the outer bark till the area shows white, then painting with the solution first mentioned, to which has been added glycerine to prevent evaporation before the disinfectant can strike in. The Bartlett variety is highly susceptible.

Codling moth is the worst insect of the pear throughout California; for further discussion of this pest, see the section on the apple.

Pear thrips is a tiny insect that attacks the fruit buds, blossoms, and fruit when they are very small, causing blemishes that may destroy the fruit buds or ruin the pears. A  $2\frac{1}{2}$  per cent nicotine dust is very effective if the temperature is 70 degrees Fahrenheit or above and the air is still. Derris products are also effective, either as sprays or as dusts. (See footnote 7, page 26.) Heavy watering of the trees in October tends to destroy the hibernating pupae.

Italian pear scale occurs in colonies under the moss or old bark and may cover the trunks and main branches. It may greatly weaken the tree. Spray in January and February with heavy commercial oil emulsion. (See footnote 7, page 26.) Thoroughly drench the limbs and the trunks.

*Pecan*.—Pecan trees grow so large that they are more adapted to waste places along streams than to the home orchard (fig. 28). In the country, however, one or two pecan trees might well be planted somewhere around the farm buildings, as they make a fine shade when they grow up. Although the seedlings will grow everywhere, the improved varieties do not always thrive in the interior climate. The pecan, a deep-rooted, moisture-loving tree, is unsuited to dry places or to places with an impervious subsoil. Being extremely susceptible to little-leaf, it should be planted only in the best of soils. Both seedlings and varieties ripen very late, usually after the leaves are off. Some seedlings and occasionally a variety do not ripen all their nuts. The Schley, an old favorite, comes into bearing earlier than others. This and the Burkett make a good pair. The Success and Nillis are suggested for the south.

*Persimmon*.—The Japanese or Oriental persimmon is very desirable in a home planting; the trees not only bear heavily of delicious fruit but are very ornamental (fig. 29). They need no attention except some trimming to keep them shapely and well balanced to avoid breakage. Interfering branches should be removed early. The persimmon will stand a temperature of 0 degrees Fahrenheit. Though it thrives best in the interior valley, it may be grown fairly well all over the state; it succeeds under widely varying conditions of soil and climate. In planting, a deeper hole will be necessary than for other deciduous trees except wal-

nuts and pecans, for it is likely to have a rather long taproot. Hachiya and Tanenashi are the leading varieties. The fruit must be served soft ripe; only then does the astringency disappear. One can remove the astringency artificially and still retain the firmness by placing the fruit in a tight container and exposing it to the fumes of alcohol for about 10 days. The Fuyu, a nonastringent variety, can be taken right off the tree and eaten like an apple; but, since it is not a popular market sort, trees



Fig. 29.—Japanese persimmon trees. At the left is the variety Hachiya, and at the right, Fuyu. The fruit of the latter is nonastringent and can be picked and eaten like apples.

are difficult to obtain. Unfortunately it does not seem to live so long as the others on the common rootstocks.

*Pistachio*.—The pistachio tree (*Pistacia vera*), which bears the small nuts often used for flavoring ice cream, is easy to grow especially in the interior of the state. The trees may attain a height of 25 or 30 feet, though 20 feet would be an average size. Since the pistachio is dioecious—that is, has the male and female flowers on separate trees—one must plant two trees, selecting the pistillate, or female, for its nut-bearing qualities. The variety Bronte is suggested, with Kaz as a pollinizer. If one of the branches is grafted to a pollinating sort, only one tree will be necessary. The tree is free from enemies. Because of delayed foliation, it is not adaptable to the valley floors of southern California.

*Plum and Prune*.—The prune is merely a type of plum with a high sugar content, that ripens on the tree and drops off of its own weight. It may then be dried in the sun, preferably having first been passed over a needle board to puncture the skin, which facilitates the drying process. Plums, on the other hand, will not dry without fermenting around the

pit. Growers who market prunes commercially dip them first in hot lye, then in clear water; pass them over the needle board; and finally place them on the drying trays. Care of prune trees is exactly the same as for plums.

We are concerned with three distinct types of plums. The first is the European plum, which includes all the so-called "blue" plums so largely shipped to eastern markets and also includes the prunes. The second is the Oriental or Japanese plum, the so-called "red," early-blooming sort that includes many popular shipping varieties. The third type might in general be called the native American plum, of which there are several subtypes and many different species.

All the plum trees are hardy. The Japanese type, however, because of its early-blooming habit, is unadapted to the higher elevations. It does not thrive along the coast or in the coastal valleys, but it is at home in the interior and fairly so in the foothills. The European type thrives wonderfully well in all the coastal valleys and may be grown up to an altitude of 2,000 feet in the mountains. It also does well in the interior. The native American plums are best adapted to mountain regions; some of the wild ones, native to California, will fruit at altitudes of from 5,000 to 6,000 feet. The native eastern plums of the Wild Goose type would do well up to 3,000 or 4,000 feet. Although they will grow in the interior valleys, it is not advisable to plant them there, for the European and Japanese types are much better.

Plums of all kinds are usually propagated on myrobalan plum stock, a moisture-loving plant. They will stand much wetter locations than peaches and nectarines but will not live where water stands in the soil for more than a few days at a time. Of their numerous enemies, none are serious enough to prevent culture of the tree in the home garden.

Prunes make good plums for eating out of hand if one likes a very sweet fruit. The French variety thrives everywhere, but the fruit is small. For the table the Sugar would perhaps be more satisfactory. The fruit of the Imperial is very large, but the trees are inclined to be shy bearers. Tragedy, which is self-sterile, and Grand Duke, are excellent blue varieties and they pollinate each other. The Burton (used either as a plum or a prune), is large and of good quality. The Santa Rosa, Satsuma, and Elephant Heart are three good Japanese plums. The Elephant Heart, the last plum originated by Burbank (it was introduced after his death), is regarded by some as his best for eating purposes. It is very large, deep red, and red-fleshed. Unfortunately it does not set fruit from its own pollen; and since no satisfactory pollinating variety has been found thus far, it is apt to be a shy bearer. Also, being a patented



Fig. 30.—Mature prune tree. Note the extensive system of fruit-bearing spurs. There are too many small branches. The top is too dense, and the spurs in the interior are losing their vigor. (From Ext. Cir. 41.)

variety, it costs more than ordinary trees. The Satsuma also has red flesh and is a favorite for cooking. At high altitudes plant *Prunus subcordata*, the wild Sierra plum that is famous for jelly-making purposes.

In the south most of the Japanese plums do fairly well. For all-round planting the Santa Rosa is the most satisfactory, producing a crop regularly under warm valley conditions. The Beauty, Becky Smith, Burbank, and Abundance, properly paired for pollination, would also be acceptable. The Sugar prune will also tolerate southern climatic conditions, but the Italian prune and the others of its group are not adapted to the warm southern valleys. For other varieties of plums and prunes, see the tabulated lists 79 and 80.

Plums bear most of their fruit on spurs but some of it on one-year wood as with the peach. As the spurs generally live five to eight years, these fruits, except the Japanese plum, require lighter pruning than the apricot. Unless the trees are lacking in vigor, the pruning for plums should be mostly a "thinning-out." From 12 to 24 inches of new growth each year is a desirable amount under most conditions.

In its fruiting habit the prune resembles the other plums except that as the trees become older the fruit is borne almost entirely upon spurs (fig. 30). The reason, of course, is partly the method of pruning commonly employed. A regular light thinning of the smaller branches ( $\frac{1}{2}$  inch or less in diameter) is better than the spasmodic heavy pruning often given to bearing prune trees. The spurs in old trees are often long, slender, and much branched, in need of a thinning out and a cutting back to one of the more vigorous branches of the spur. The desirable amount of new growth is about the same as with almonds. The Sugar variety, because of its brittle wood and its tendency to overbear in alternate years, must be pruned more severely than others (fig. 31). Because most Japanese varieties tend to overbear, pruning is somewhat heavier than with European varieties except the Sugar prune. Judicious pruning will materially reduce the amount of hand-thinning of the fruit (fig. 32). Trees growing on the shallower or drier soils may require relatively heavy cutting to reduce the yield and increase the size of the fruit. On the early training of the trees see pages 15 to 20.

Armillaria, or oak-root fungus, is discussed under the almond; brown apricot scale under apricot; and the red-humped caterpillar under the apple.

Red spiders are somewhat pale-green or yellow mites that appear in mid- and late summer and greatly damage plum and prune trees by causing the leaves to fall prematurely. Dusting and spraying as recom-

mended for the almond mite should be done very thoroughly and continued until the first good rains occur in the fall.

The Italian pear scale is discussed in the section on the pear.

The mealy plum louse is a pale-green aphid covered with a fine white mealy wax; it collects in great numbers on the undersides of tender

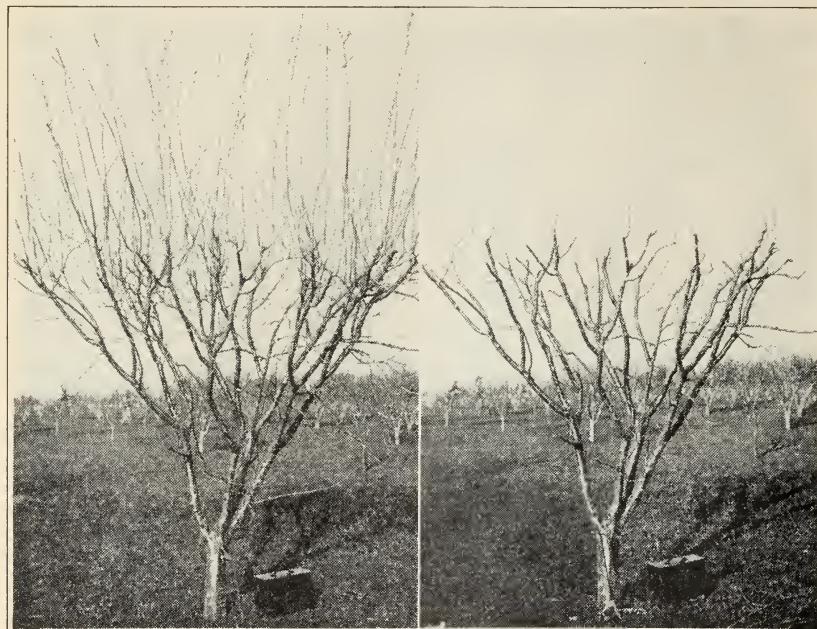


Fig. 31.—Because of its brittle wood and its tendency to overbear in alternate years, with consequent breakage of branches, the Sugar prune must be pruned more severely every year than other plum varieties of the European type. Tree shown before and after pruning.

leaves and shoots in May and June. The eggs may be destroyed by tar oil emulsion or dinitro (short name for dinitro-o-cyclohexylphenol) during the dormant period (see footnote 7, page 26). Spraying with  $1\frac{1}{2}$  to 2 gallons of light summer oil and  $\frac{1}{2}$  pint of nicotine sulfate to 100 gallons of water as the leaves begin to curl will control the aphids after the eggs hatch.

**Plumcot.**—Beginning in 1901 and through succeeding years Burbank advertised several varieties of "plumcot," a cross between an apricot and a Japanese plum. Since then M. Sharpe and R. E. Burton of Vacaville, California, have made the same cross. The fruits are characteristically large but often resemble the apricot externally; the skin is fuzzy as in that fruit, but the color may range from bright yellow to mottled red. The flesh also has similar variations in color. The quality in the dif-



Fig. 32.—A dooryard Japanese plum tree, variety Satsuma, after pruning. Note that all the principal branches are clothed with fruit-bearing spurs. Severe hand-thinning may be necessary to keep the fruit from being too small.

ferent varieties ranges from very good to poor. The Apex, formerly listed as a plumcot, is now regarded as a plum, and the Yakimene as an apricot. Still rated as plumcots are the Rutland, Sharpe, and Stanford. The cultural requirements are the same as for the apricot.

*Pomegranate*.—The pomegranate is usually planted as an ornamental; it makes a sturdy shrub 6 to 10 feet high that may be trained as a bush or left to spread from the crown and become a clump. The large, red flowers, lasting several weeks, are highly attractive; and the numerous fruits are showy, particularly those that turn red in autumn. The fruits may be 3 to 4 inches in diameter and are almost the shape of an apple. They contain a great mass of hard seeds; but the tissues surrounding these are filled with a sweetish, highly acid, somewhat astringent juice, which when squeezed out makes a sprightly drink. The pomegranate thrives in almost any part of California where the temperature does not go much below freezing. It has no serious enemies. The Wonderful is a variety with highly colored fruit.

*Prune*.—For a discussion of prunes see the section on the plum.

*Quince*.—The quince is hardy in all climates where ordinary fruits can be grown. Because of its late-blooming habit, it escapes spring frost. Although it does best in a good soil, it withstands more abuse than most fruits and is therefore often grown in spots unadapted to other trees. It has no serious enemies and requires little pruning except a slight annual trimming to remove interfering branches (fig. 33). The Smyrna would perhaps be the best single variety.

*Raspberry*.—There are two kinds of raspberries—the red and the so-called "black-cap" or "purple-cane." The red raspberries are adapted to the entire coastal region, do fairly well in the interior valleys, and are hardy even in the mountains. They are planted in rows 6 feet apart and 3 feet apart in the row. Being upright growers, they need no trellising. They spread from the roots and will soon form a solid hedge. Each year, after the fruit is harvested, the old canes should be cut out. Pruning will consist of tipping the sprouts when 18 inches high to cause them to branch. Then, in winter, the side branches should be tipped. Only enough fruiting canes should be left to permit them all to assume their natural habit of growth. A little experience will teach how many to leave for best fruiting results.

Perhaps the best red raspberry would be the Ranere, sometimes known as St. Regis, which under coastal conditions produces a fall as well as a summer crop. The Cuthbert, also known as Cassberry, is especially popular in the southern part of the state.

Black-cap raspberries thrive only in a coastal climate or in the moun-

tains. In habit they are semitrailing, and the branch system may be supported on a single wire  $4\frac{1}{2}$  feet high or on a two-wire horizontal trellis of the same height. The vines spread only if the tips of the drooping branches are allowed to touch the ground and take root; otherwise they



Fig. 33.—Mature quince tree, variety Burbank. Note the characteristic warty growths on the main branches. This is not a diseased condition.

remain in hills 4 to 6 feet apart as originally planted. The rows should be 6 feet apart.

In early summer of the first season, when the canes are about 2 feet high, they are tipped to cause them to branch. At the main pruning, which takes place after the leaves are off, the excess canes are cut out; and the side branches of those remaining are shortened back to 6-inch stubs. About five canes should be left for fruiting purposes. For additional information on pruning, see the section on blackberry.

The black-cap raspberries, though somewhat seedy, are juicy and

finely flavored. In the market, they bring a much higher price than the red raspberry. They are very popular for jams and jellies, whereas the red raspberries are too soft for cooking. The latter are usually served fresh with sugar and cream. The best variety of black-cap is perhaps the Munger.

Although raspberries have several enemies, verticillium wilt is perhaps the worst. Since this is a soil disease carried by potatoes and tomatoes, raspberries should never be planted where these crops have been grown within the past several years. There is no good remedy except to cut out affected parts and burn them and also to rake up and burn the dead leaves. Disease and insect control are discussed under blackberry.

*Strawberry*.—This delicious fruit has a place in any home planting. Fortunately it thrives even where there is much snow and heavy freezing weather, provided the plants are covered, while the ground is frozen, with a 4-inch layer of clean straw. If early irrigation is unnecessary or if the watering can be done by sprinklers, the mulch can be left on until after the fruit is harvested. Be careful to secure young plants with white roots for setting out. They may be planted 14 inches apart in a row; or staggered on a raised ridge 12 or 14 inches wide; or in solid beds, which may or may not be raised. In any case, they will soon cover all the space not used for cultivation.

The strawberry spreads by means of runners, which creep along the ground and take root at every other joint. The object of growing the berries on a raised ridge is to make it easy to irrigate them without wetting the leaves and fruit, by allowing the water to flow in the ditches between the rows. If they are grown in beds, a levee can be thrown up around them, and water supplied by flooding; but this arrangement will ruin much of the fruit, which becomes dirty or rots when in contact with the wet soil.

In the East mostly a one-crop variety is grown. Everbearing sorts are also available that can be relied upon to produce both a summer and a fall crop. In California are varieties that might be called true ever-bearers, fruiting continuously throughout the season.

Klondike is the standard variety for the southern part of the state. The fruit is of medium size, but becomes small at the end of the season. It produces heavily in the spring but has no fall crop. For the central coastal region the Marshall (Banner) would be satisfactory. The fruit is medium to large, conical, often rough with an irregular surface, and deep red, with a tendency to remain white on the unexposed side; the quality is excellent. Marshall is very susceptible to the yellows and crinkle diseases but resistant to verticillium wilt. It does reasonably well

on heavy or moderately wet soil. A standard variety, it is more widely used than any other in the central valley section and northern part of California. In the central part of the state, including the Sacramento district, the Oregon, of the same type and general appearance, is also very popular. Among the everbearers, Rockhill 26 is highest in quality but is susceptible to the verticillium disease. The berries are medium to large, of good appearance. The variety forms few or no runners and can therefore be planted in hills 2 to 3 feet apart. To propagate it one must subdivide the old plants, using the newest and whitest parts. The Rockhill will bear itself to death very promptly unless disbudded until the plants are at least 3 months old, stand 8 inches high, and have a spread of 1 foot. The worst disease of strawberries is the verticillium wilt. Diseased plants must be dug out. Do not plant strawberries where tomatoes or potatoes have been grown, as this is a soil disease carried by these crops.

*Walnut.*—The walnut thrives both under coastal and interior-valley conditions, also on mountain slopes and in mountain valleys up to 3,000 feet elevation. In high places where there is danger of late spring frost, however, late-blooming varieties like the Franquette should be planted. Since walnuts form large spreading trees, they are unadapted to the home garden and are best planted in the barnyard or along avenues for their shade (fig. 34). The tree is not exacting as to soil, but it must be watered a few times during the year in order to produce good crops. Though the walnut is affected with certain pests like codling moth, aphids, and a blight disease that attacks the twigs, leaves, and fruit, little control work can be done by the home owner, because the trees are too large to be sprayed except with a power outfit.

In planting a walnut, perhaps the safest plan for the beginner would be to cut the tree back to two or three buds (8 to 12 inches from the ground) and grow a new head by leaving only one sprout (fig. 1). The others should be retarded by pinching out the tips during the early summer. In planting, deep holes may be necessary, as the trees may come from the nursery with a long taproot. The trees should not be allowed to head out too low if it is desired to have the branches high enough to walk beneath them. The walnut is peculiar in that the tips do not continue in the direction they start : new growth each spring comes from a bud a few or several inches back from the terminal, and on the underside. After a few years a branch will be almost horizontal to the tree ; and under its own weight, plus a crop of nuts, it will soon sag almost to the ground. If the top is not cut back the tree will branch naturally. Branches lower than 5 or 6 feet may be cut away the second year, the terminal being

allowed to continue growing. Where possible, the branches should be spaced 18 inches apart. To prevent breakage from the wind the first year, the tree should be tied to a stout stake.

Later pruning of the walnut should be moderate. Remove superfluous and interfering branches while small and always when dormant. To cut



Fig. 34.—Concord walnut seventeen years old. The trees grow too large for most dooryards.

off branches 4 inches in diameter or larger is hazardous because the wounds may heal with difficulty. In the home orchard the first two years will determine the branch arrangement and the shape of the tree. If this preliminary work has been carefully done, little pruning will be necessary thereafter.

For home use in the Sacramento and San Joaquin valleys and in the north coastal region, the French varieties are generally best: they are high in quality, resistant to blight and codling moth, and not often injured by frost. This group includes Franquette, Mayette, and many varieties developed as seedlings from these and related sorts such as Treat Franquette, Hartley, San Jose Mayette, and Triple-X Mayette. This last is a good pollinizer for the Treat. The Eureka, although a somewhat unreliable bearer, has certain advantages for home planting in northern California: it produces a large nut of good quality, with a hard shell and a very tight seal that largely resists the invasion of the storage moth. The Concord, though of lower quality than those mentioned, is extensively planted in the Sacramento Valley because it is easily grown and bears well. For southern California the Placentia and Chase are recommended, but they must be budded on white-walnut root.

Crown rot is beginning to be the most destructive disease of the walnut, for it attacks trees on black-walnut root. It kills many trees in home plantings each year, particularly when it is grown on a lawn or with flowers or vegetables and is therefore watered frequently. The disease is caused by a soil fungus that attacks the bark of the crown just below ground. Wet soil may cause rapid development of the disease. Trees grown on white (English) stock or Paradox hybrids are more resistant than the northern California black. Remedial measures would be to keep irrigation water well away from the crown or to remove the soil from around the crown so that the part can dry out quickly. If an open hole is undesirable, it may be filled with stones, which would allow free circulation of air.

Walnut blight is another destructive disease. Though it varies considerably in severity from year to year, it is usually worse in the foggy coastal districts than in the inland valleys. A bacterial disease, it attacks the young and tender growth as well as the more mature wood, blackening and killing the affected areas. It also attacks the nuts, making them turn black and drop off when very small. It causes full-sized nuts to become blanks, or spoils their appearance by staining the shell. It shows on the nut as black spots, most prevalent at the blossom end but often scattered over the entire surface. Unfortunately there is no specific remedy.

Codling moth is a major insect pest of the walnut in the south, although fortunately it has not yet become prevalent in all parts of the state. Every variety is attacked; but Placentia, Chase, and Payne are the most susceptible, whereas Eureka and Franquette appear more resistant. Spray with basic lead arsenate at the rate of 4 to 5 pounds to 100

gallons of water. If aphids are present add  $\frac{3}{4}$  to 1 pint of nicotine sulfate. If spraying is impracticable, dust with a mixture of basic lead arsenate (see footnote 13, page 63) mixed with dehydrated lime at the rate of 40 per cent of poison to 60 per cent of the lime by weight.

Red spider occurs occasionally in the dry, interior valleys during mid- and late summer on trees where soil moisture is deficient. The only safe treatment is to use a dust based on a dinitro compound (see page 71). Sulfur dust, though effective, burns the foliage.

Walnut aphid ranks second to the codling moth as a walnut pest. The insects not only withdraw considerable sap from the twigs but give off a honeydew in which grows a sooty-mold fungus. They cause heavy dropping of the leaves during midseason, and this may result in sun-burning of the nuts and possibly of the main branches. Four to 5 per cent nicotine dust is perhaps the most practical remedial treatment (see footnote 7, page 26).

*Young Berry*.—For a discussion of Young berry, see the section on the blackberry.

#### CONDENSED PLANTING LISTS OF FRUITS AND NUTS

For convenience in making up planting lists, the desirable varieties for the different climatic regions of California are herewith presented in tabular form. In the first two lists the fruits are arranged in the order of their importance and the varieties are given in the order of time of ripening. Pears and apples are not included in the valley regions because of the difficulty in controlling the codling moth and fire blight.

##### VARIETIES FOR A ONE-ACRE HOME ORCHARD IN THE CENTRAL AND NORTHERN COASTAL REGION AND LOW MOUNTAINS (UP TO 3,000 FEET)

Apple.....	2 each of Red June, Yellow Transparent, Gravenstein, Golden Delicious, Grimes Golden, Jonathan, Delicious, Spitzenburg, Yellow Newtown, and Winesap.
Plum.....	2 each of Beauty, Santa Rosa, Burbank, Tragedy, Satsuma, Elephant Heart (only if a pollinizer can be assured), Yellow Egg, and President. (The Tragedy is self-sterile but is pollinated by the Sugar prune, mentioned below.)
Cherry.....	2 each of Black Tartarian, Royal Ann (Napoleon), and Montmorency.
Apricot.....	2 each of Royal and Moorpark.
Pear.....	2 each of Bartlett and Comice.
Prune.....	2, French, and 1 each of Burton and Sugar. (The Sugar is a satisfactory pollinizer for the Tragedy plum.)
Walnut.....	1 each of Treat Franquette, Triple-X Mayette, Eureka, and Concord.

Quince.....	2, Smyrna.
Chestnut.....	2, Italian seedlings.
Persimmon.....	1 each of Hachiya, Tanenashi, and Fuyu.
Filbert.....	2, Barcelona ; 2, Du Chilly ; and 1, White Aveline.
Blackberry.....	5 each of Lawton, Crandall (Macatawa), Himalaya, Mammoth, and 10, Boysen.
Currant.....	5, Perfection.
Gooseberry.....	5, Houghton.
Raspberry.....	10, Ranere (St. Regis).
Peach.....	1 or 2 each of St. John, White Heath, and Salwey. Planting not recommended except in warm spots or well away from direct influence of the ocean (cold winds, summer fogs), or at altitudes well below 2,000 feet.
Grape.....	Same conditions as for peach. Two or 3 each of Pearl of Csaba, Chasselas doré, Conecord, Pierce, Niagara, and Iona. The last 4 are slip-skin or eastern varieties.

VARIETIES FOR A ONE-ACRE HOME ORCHARD IN THE SACRAMENTO AND SAN JOAQUIN VALLEYS AND ADJACENT FOOTHILLS

Peach.....	2 each of Florence, Hale Early, Triumph, St. John, Ideal, J. H. Hale, Curry, White Heath, Paloro, and Salwey.
Plum.....	2 each of Beauty, Santa Rosa, Burbank, Tragedy, Satsuma, Yellow Egg, Elephant Heart (only if a pollinizer can be assured), and President. (The Sugar prune, mentioned below, is a satisfactory pollinizer for the Tragedy plum.)
Nectarine.....	2 each of John Rivers, Gold Mine, Gower, and Victoria.
Almond.....	2, Nonpareil, and 1 each of Ne Plus Ultra and Jordanolo.
Apricot.....	2, Royal, and 1 each of Tilton and Moorpark.
Cherry.....	2 each of Royal Ann (Napoleon), Black Tartarian, and Montmorency.
Prune.....	1 each of French, Burton, and Sugar. (The Sugar will serve as a pollinizer for the Tragedy plum.)
Walnut.....	1 each of Treat Franquette, Triple-X Mayette, Eureka, and Concord.
Persimmon.....	1 each of Hachiya, Tanenashi, and Fuyu.
Fig.....	1 each of Mission and Kadota.
Quince.....	1, Smyrna.
Grape.....	2 each of Thompson Seedless, Red Malaga (Molinera), Ribier, Muscat of Alexandria, Flame Tokay (Sacramento and San Joaquin counties only), Olivette Blanche, and Emperor.

VARIETIES FOR A HOME ORCHARD (OF NO PARTICULAR SIZE), IN THE COAST AND VALLEY AREAS OF CALIFORNIA SOUTH OF THE TEHACHAPI RANGE

Apple.....	Winter Banana, White Pearmain, Red Astrachan.
Apricot.....	Royal, Newcastle.
Cherry.....	Morello (sour).
Fig.....	Turkey (Brown Turkey), Kadota, White Genoa, Mission.
Peach.....	C. O. Smith, Babcock, Lukens Honey.
Pear.....	Bartlett, with Winter Nelis as a pollinizer, Flemish Beauty.
Plum.....	Santa Rosa and Beauty (both should be planted to insure pollination).
Persimmon.....	Hachiya, Fuyu (on rootstock of <i>Diospyros virginiana</i> ).
Quince.....	Smyrna.
Grape.....	Pierce, Niagara, Thompson Seedless.
Almond.....	Nonpareil and Ne Plus Ultra (both should be planted to insure pollination).
Pecan.....	Success, Nillis.
Walnut.....	Placentia.
Blackberry.....	Crandall (Macatawa), Boysen, Logan (Thornless), Young.
Raspberry.....	Cuthbert.
Strawberry.....	Dorsett, Rockhill.
Avocado.....	Fuerte, Mexicola, Anaheim.
Cherimoya.....	Booth, Deliciosa.
Orange.....	Washington Navel, Valencia.
Lemon.....	Eureka, Meyer.
Grapefruit.....	Marsh.
Lime.....	Bearss.
Tangerine.....	Dancy, Clementine.
Feijoa.....	Coolidge, Superba (both necessary to insure pollination).
Guava.....	Strawberry.
Loquat.....	Early Red, Champagne, Premier, Thales.
Pomegranate.....	Papershell.
White sapote.....	Pike, Suebelle.

#### DWARF FRUIT TREES

In this country comparatively few persons have explored the possibilities of dwarf fruit trees for the home garden. In Europe the partial dwarfing of peaches and pears and the complete dwarfing of apples are common practices. Europeans have also perfected special methods of training known as espalier and cordon, with numerous variations, which cause the trees so treated to be smaller than normal. Climatic conditions of western and southern Europe are very well adapted to fruit growing,

and the people as a whole are far more garden-minded than we are. Since, however, land is scarce and the average citizen with a tiny garden wants to grow as many things as possible, dwarf fruit trees seem to have been the answer to his problem.

Most if not all of our deciduous trees are reduced below their normal size in three general ways: by heavy pruning, especially in summer; by partially starving the roots by confining them in pots or boxes; or by grafting them upon the roots of other trees that naturally grow more slowly or remain smaller. The use of dwarf or partially dwarfing stocks is the method chiefly employed both here and abroad, although careful pruning is important in holding down excessive wood growth and in keeping dwarfed trees both small and fruitful.

Although pears are commonly grown as dwarfs in this country, dwarf apples are seldom seen. In Europe peach trees are reduced in size in order to adapt them to cold foggy climates by growing them against walls or under glass. The small need for such special-purpose trees in this country accounts for their scarcity.

Dwarfing a tree is popularly supposed to shorten its life. This is not necessarily true, although in practice dwarf trees are often permitted to overbear and consequently do not live so long as they might otherwise do. Under expert management such as English and French gardeners give their trees, dwarf pears, for example, may live to a ripe old age.

*Dwarf Apples.*—The Paradise apple, a natural dwarf, serves as a stock for reducing the size of any variety of apple grafted upon it. On this stock trees may be so much reduced in size that they can be grown in 10- or 12-inch flower pots. If planted in the ground they will range in height from 3 to 6 feet, the height depending upon the variety (fig. 35). The training they receive—that is, the kind of pruning—has much to do with their size. The Doucain apple is a natural half-dwarf. Varieties grafted upon that root attain about half their normal size.

Dwarf apples are trained to various shapes. The young trees are often set 2 or 3 feet apart and made fast to a three-wire trellis for no particular purpose except the ornamental effect they give. They are generally tilted over at an angle of about 65 degrees and kept pruned to a system of spurs (fig. 36). They will begin bearing the second year. This is a favorite method of training in the English fruit gardens, but the trees require much detailed attention. It would be safer for the amateur to set them about 4 feet apart.

Another method of training, a favorite in Continental gardens, is the “cordon” style. This requires one-year-old trees with straight trunks 5 or 6 feet long and, if possible, without branches. They are planted against

a single-wire trellis 18 to 20 inches from the ground and about 6 feet apart. Beginning at one end of the row, the gardener bends the tree over as nearly as possible to a right-angle turn, ties it to a stake to hold the stem upright, and also ties it to the wire to hold it in a horizontal position. He then treats the next tree similarly and so on, with all trees pointing in the same direction except that the one at the end may be



Fig. 35.—Dwarf apple tree, variety Lane's Prince Albert, on Paradise root. The tree is about five years old and 6 or 7 feet high. East Malling Research Station, East Malling, Kent, England.

pointed the opposite way. When the first tree in the row has grown until it reaches the second, it is grafted into the trunk on a level with the wire. The others are treated the same except that the end tree, which has been turned in the opposite direction, will be grafted into the tip of the tree that it meets rather than into the trunk. The trees, when grown together, form a living cordon both unique and ornamental (fig. 37). Such cordons are used as borders for driveways and garden paths. They must be kept carefully pruned, as nearly as possible to a system of spurs. Much summer pruning may be necessary; with European gardeners, this consists mostly of pinching out terminal buds and undesirable twig growth.

Dwarf apple trees usually bear too heavily but, if judiciously thinned, will produce larger fruit than the same variety does on standard roots. Even with only fair treatment, dwarf apples should live for twenty-five years, provided they are kept fertilized, are properly pruned, and are

not allowed to overbear—the last being the most important. Under ideal conditions they will live much longer. In a dry climate, since the root system is small and shallow, they must be carefully watered. If treated as border plants and watered accordingly, they should grow satisfactorily. If allowed to suffer for water even for a few days, however, they may be sunburned at the point where they are bent over and thus become infested with flat-headed apple tree borers, which will quickly

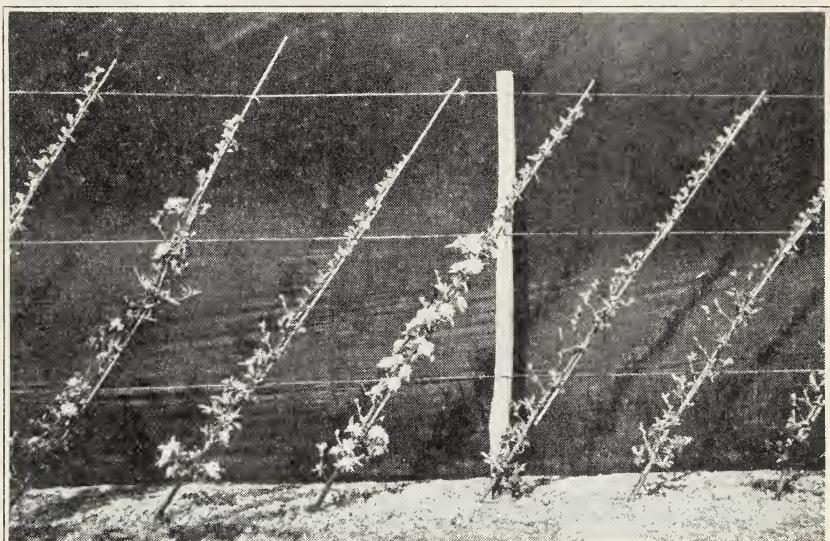


Fig. 36.—Dwarf apple trees beginning to bear one year after planting. Trained to a three-wire trellis. East Malling Research Station, East Malling, Kent, England.

girdle the trunk. Along the coast or in the coastal valleys it should be easy to grow apples "cordon" style or in any other dwarf form.

On the Pacific Coast there is a growing interest in espaliered apple trees; such trees are offered for sale already trained in various shapes and designs. They are growing in boxes of soil and, when planted, will bear the same year, as the roots may be three or four years old. They may be trained on a wire trellis or against a wall. In Europe, on the other hand, the present writer did not notice a single espaliered apple tree during 30 months of travel and sojourn in a dozen different countries. Though there may be some, they are certainly not common, whereas espaliered pears are universal. In California, however, the apple would be safer than the pear for espaliers because of the danger of pear blight, a disease that is not a problem in Europe.

*Dwarf Pears.*—The pear is dwarfed by budding or grafting it upon quince root, the Angers quince being the stock generally used. Pears so

grafted may be purchased from almost any nursery. The Bartlett, a popular pear, will not make a good direct union with the quince. The tree, therefore, is double-worked by grafting the quince to a Hardy or some other variety that does make a good union, letting it grow one season, then grafting it to a Bartlett. Dwarf pears are trained in various ways. In this country they are planted in orchard form 12

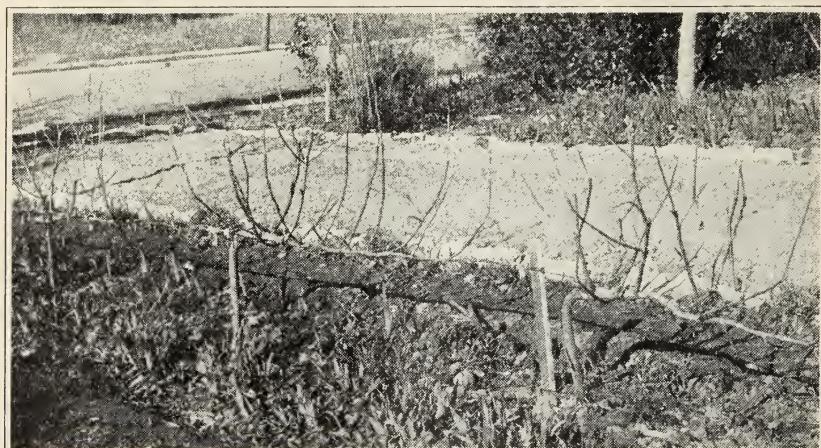


Fig. 37.—Apples trained cordon style; age four years. The tree at the right, variety Gravenstein, bore seven apples the second year after planting in Davis. When the horizontal-growing trees meet, they are grafted into each other to form a living cordon.

to 16 feet apart each way and then handled like standard trees. They will attain a height of 10 feet or perhaps more but can be kept smaller by pruning. In European gardens they are always grown espalier style and trained in various ways, some truly fantastic. One common method is to flatten them against a garden wall or against the individual spikes of a picket fence. Many ornate iron fences surrounding parks or public gardens have pear trees trained against them. Perhaps the tree will be caused to fork, forming many branches near the ground, each of which is trained against a separate picket (fig. 38). Another geometric form is that of the "specimen" tree, which stands in the open with the branches trained to grow on the horizontal in four directions. The tree is tied to a small post, which is made the center of a trellis running in two directions—say east and west, and north and south. The trellis will consist of several wires (five to eight) 12 or 15 inches apart. When the horizontal branches have reached a length of about 3 or 4 feet they are caused to turn upward by being bound to a stake. Upon reaching the next branch

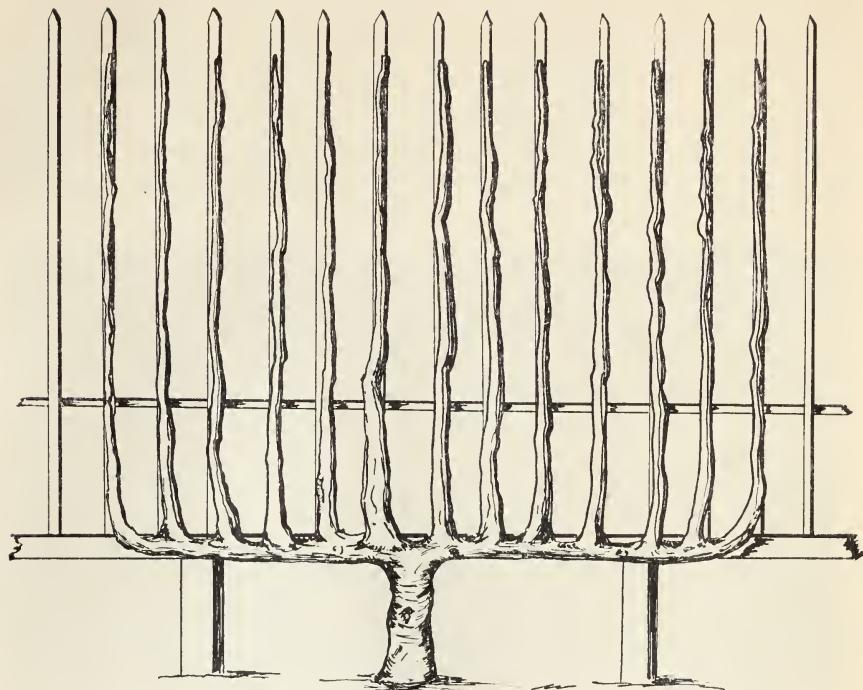


Fig. 38.—Espaliered pears at the Experiment Station of the Province of Saxony. The branches are trained against an ornate picket fence. The diagram shows in detail how the trees are trained.

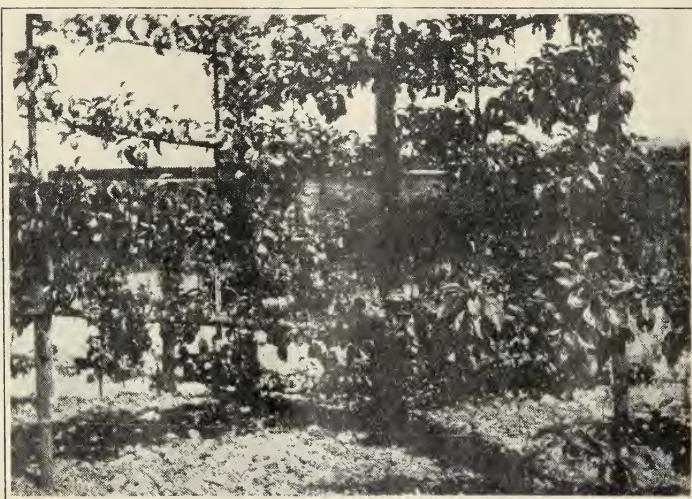
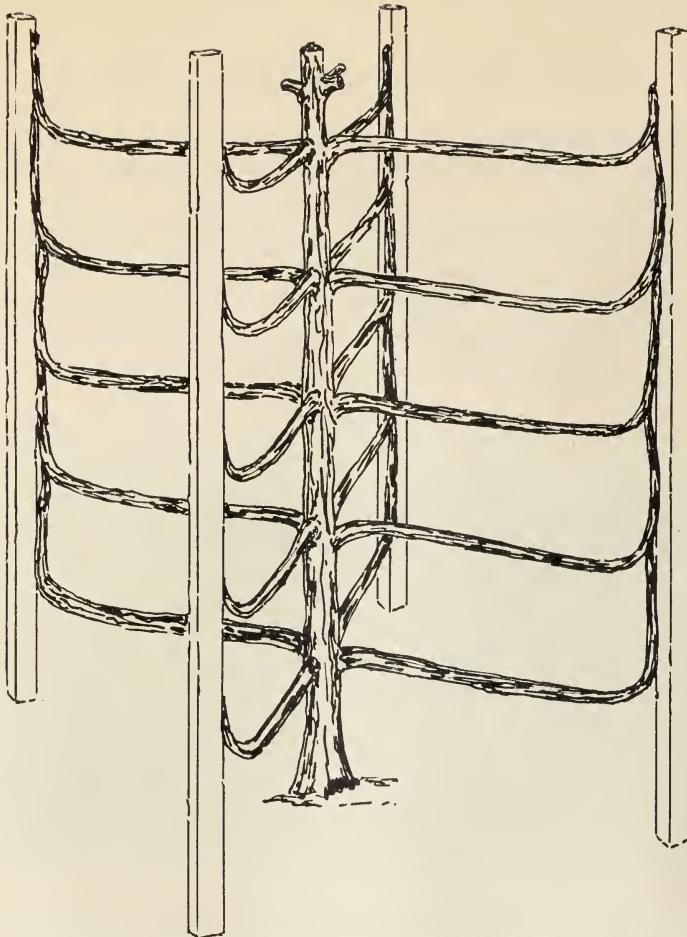


Fig. 39.—Pear tree with branches trained to grow horizontally in four directions from the trunk. When a branch has reached the required length, it is caused to turn upward and grafted into the next branch above. See the diagram for the complete plan.

above, they are grafted into it. If the work is carefully done the trees, at about eight or ten years of age, present a striking effect (fig. 39).

Another common way of training pears is to plant them along a five-wire trellis and to train the branches so that they will grow in a horizontal position in two directions (fig. 40). When the branches meet they are grafted together, thus forming a series of living cordons across the garden. In this country, where pear blight is prevalent, only the most resistant varieties should be used for espalier purposes.



Fig. 40.—A single tree in a row of old pear trees in the town of West Malling, Kent, England. The branches, trained originally on wires, are now supported by stakes. When the ends of the branches met, they were grafted together, which formed a series of living cordons across the garden. Growth has been reduced to a system of spurs. Heavy fruit-bearing discourages shoot growth. The English climate is not favorable to pear blight.

*Espaliered Peaches.*—The peach is considerably dwarfed by budding it upon the St. Julien plum. This procedure reduces the size of the tree by 40 to 50 per cent. If grown under glass for forcing fruit out of season, the tree should be planted on the east, west, or south side of the room, and the branches trained to rest as nearly as possible against the glass (fig. 41). This is the method of growing hothouse peaches in England, Belgium, and in other regions where there is much fog and cloudy weather.

The most common use of dwarf peaches is to form espaliers against a wall. The trees are caused to branch profusely at the ground, and these branches are trained against the wall in the shape of a fan (fig. 42). Fruit can be grown this way only in a cool climate, where, of course, a south wall should be selected. In England, where the mean temperature is too low to ripen peaches naturally, the wall is sometimes made hollow

to permit of being heated. There is no reason why plum trees on St. Julien stock should not also be grown as espaliers. By using *Prunus Besseyi*, the Western sand cherry as a stock, one may reduce plum, peach, and cherry trees to flower-pot size; but they demand expert handling and often disappoint the amateur.

*Dwarf Cherries*.—Sweet-cherry varieties are successfully dwarfed by budding them upon the Stockton morello rootstock. In a wet or shallow soil, where other cherry stocks do not thrive, trees can be held to a size

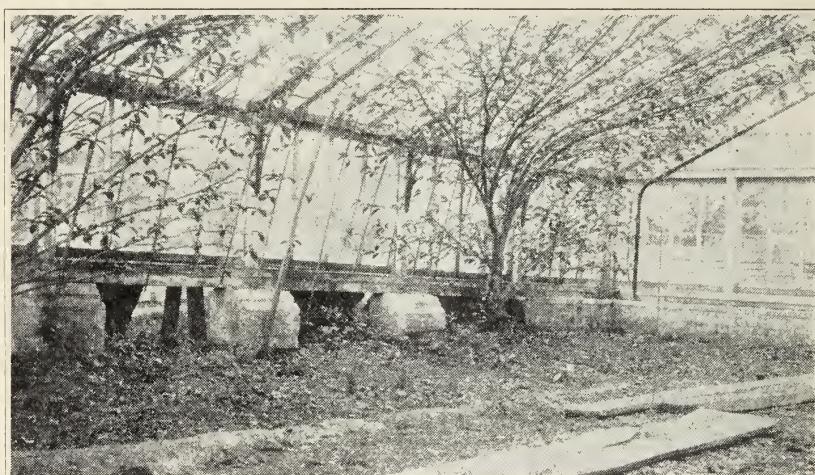


Fig. 41.—Example of peach tree grown for forcing purposes, in County Kent, England. Note how the peach has overgrown the St. Julien rootstock.

of 8 or 10 feet if trained to a spreading rather than an upright habit of growth. They begin bearing when three or four years of age. Their tendency is to overbear, in which case the individual fruits may be undersized. The remedy is to reduce the bearing wood by pruning. The Chapman is the only variety tried that does not make a safe union with the dwarfing stock.

Though the Stockton morello does not come true from seed, the sprouts that arise about the trees make reliable stock for budding. One objection to the morello stock is its habit of sprouting. Mahaleb cherry stock reduces the size of the trees considerably—though not nearly so much as the morello—and does not sprout. Chapman and Burbank do not do well on the mahaleb.

*Difficulties Encountered in Growing Dwarf Trees*.—Lest there be disappointments in growing espaliered trees under California conditions, a few difficulties should be mentioned. The first arises in connection with spraying trees trained against buildings. Our two chief sprays are lime-

sulfur and bordeaux mixture. The former would discolor an unpainted wall and blacken a painted one because of a chemical action between the sulfur in the spray and the lead in the paint; and the bordeaux would stain either a painted or an unpainted surface a most unattractive dirty green.<sup>14</sup> Spraying with arsenate of lead would leave no stain, but only a

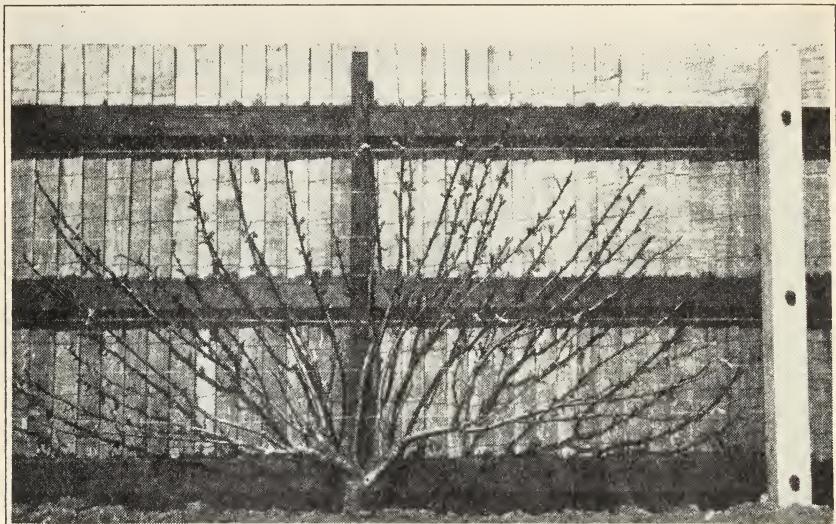


Fig. 42.—Espaliered peach grown against the south side of a board fence at East Malling Research Station, East Malling, Kent, England. Numerous wires attached to the fence hold the branches in place. The root system of this tree was four or five years old when transplanted from the nursery, where it had been espaliered. Being balled, it did not suffer from transplanting.

light deposit of lime on the wood, which could be brushed off when dry or washed off with a garden hose. Nicotine sulfate sprays used against aphids would probably discolor the wood, particularly if a soap spreader was used to make them stick.

The pear would be the safest fruit to flatten against a wooden wall, as spraying could generally be limited to arsenate of lead against codling moth to prevent wormy fruit. If the trees became infested with San Jose scale or other scale insects, an oil spray could be carefully painted on the trunk and branches with a brush.

<sup>14</sup> A possible substitute for bordeaux would be the ammoniacal copper carbonate solution sometimes used to spray ornamentals or fruit that is nearly ready to harvest. It leaves no discoloration; but the fungicidal value is not equal to bordeaux, and the expense is a little greater. The solution is made as follows: in a nonmetal vessel (wood, glass, enamel, crockery) stir 1 level tablespoonful of copper-carbonate powder in sufficient water to make a thick paste. In another vessel (of any kind) measure out  $\frac{1}{2}$  pint of strong ammonia and dilute by adding 1 quart of water. Now add the ammonia water to the paste, and stir. Finally add water to make 10 gallons of spray material.

It is not safe to try to grow espaliered pear trees in California except along the coast where blight is not prevalent. In doubtful locations, use only varieties known to possess a high degree of immunity—for example, Dearborn Seedling, Winter Nelis, Beurre Hardy, or Clairegeau. Bartlett is among our most susceptible varieties.

Peaches and nectarines should not be grown against wooden walls, as the trees must be sprayed every spring with bordeaux mixture against leaf curl. They should be grown out in the open on a true espalier, consisting of a series of wires strung between posts. On St. Julien stock and with considerable summer pruning the trees can be held down to a reasonable size. They are kept flat by tying the branches to the wires. With eight, ten, or even more branches radiating out from near the ground the trees do not grow tall, so that all needful spraying can then be safely done with a knapsack sprayer or with some other small, low-priced outfit. Espaliered pears or apples may be grown similarly except that the branches are trained on the horizontal or vertical.

Though peach-leaf curl is known in England and France, where espaliered trees are extensively grown against walls, that disease is by no means the serious problem that it is here, and gardeners do not spray against it. In both countries codling moth is exceedingly bad; but, again, little or no spraying is done. In England, at least, there is now a growing interest in spraying; but the peaches there are grown on such a small scale that they are not likely to be included in the spraying program.

Another drawback to growing espaliered trees has been the difficulty of obtaining trees upon dwarfing stock, especially in the West. The larger nurseries are now beginning to cater to this limited trade; and firms here and there specialize in espaliered trees that have been properly trained in the nursery for three to four years and are sent out growing in tubs or with the root system balled. In either case, the trees are all ready to plant and begin fruiting the first year. Naturally they are expensive as compared with ordinary trees, but amateurs who are willing to pay \$5 to \$25 for a single tree may save several years' time and avoid many possible mistakes in the training process. If, however, the home owner likes to work with trees and is willing to devote many hours to the complicated details, he may handle the whole job himself and derive enjoyment from the work.

In planting trees on dwarfing roots, one must be careful to have the point of union aboveground. If the variety part is in contact with the soil, it will take root; and the result will be a tree of standard size instead of a dwarf. This is particularly true of apples and pears.

The final drawback is the annual pruning that must be given all espaliered and cordon trees. The whole secret, in brief, is to cause all the branches to become clothed with spurs and not to allow them to form subordinate branches. The work is done mostly by pinching off the tips in summer or by removing undesirable parts entirely. Heavy fruiting also tends greatly to reduce vegetative growth. As excessive summer pruning is dangerous, some undesirable branches will insist upon starting despite all our efforts. These, of course, must be removed in winter, so that some winter pruning will always have to be done.

#### A FEW DON'TS FOR THE AMATEUR FRUIT GROWER

Do not transplant or otherwise disturb the roots of a deciduous tree or shrub while it has green leaves on it; wait until it goes dormant.

Do not cultivate the soil while it is too wet to crumble. Handling wet soil cements the particles and makes it impervious to water.

When fertilizing with *fresh* stable manure, never allow the material to come in contact with the trunk or roots of the tree. Well-rotted manure that is through fermenting is safe to use.

When planting or handling trees, do not expose the roots to sun or wind any more than necessary. Keep them covered with moist soil or with a wet gunny sack.

Do not waste time and money by planting trees that are more than two years old (unless they are growing in tubs or boxes). One-year-olds are to be preferred.

Do not fail to keep young trees adequately watered the first season after planting. If allowed to dry out and stop growing they will surely sunburn and will then be attacked and girdled by flat-headed borers. This may happen to neglected trees at any time.

Do not overwater or underwater fruit trees. Learn how much water is required to wet the soil down to where it is already moist. Merely sprinkling a dry soil does no good. Thrust a stiff wire into the ground to see whether the soil is really wet down to the roots.

**REFERENCES FOR FURTHER READING****BULLETINS AND CIRCULARS**

The pamphlets listed below were published by the University of California Agricultural Experiment Station and may be obtained free by addressing the Publications Secretary, Agricultural Experiment Station, Berkeley, California, as long as the supply lasts.

ALLEN, F. W.

1937. Apple growing in California. Bul. 425. 96 p. Revised.

BATCHELOR, L. D., and O. LEE BRAUCHER

1936. Walnut culture in California. Bul. 379. 112 p. Revised.

BUTTERFIELD, H. M.

1937. Bush berry culture in California. Ext. Cir. 80. 64 p. Revised.

CARYL, R. E.

1940. Citrus culture in California. Ext. Cir. 114. 48 p.

DAVIS, LUTHER D., and WARREN P. TUFTS

1940. Pear growing in California. Ext. Cir. (In press.)

ESSIG, E. O., and W. M. HOSKINS

1934. Insects and other pests attacking agricultural crops. Ext. Cir. 87. 156 p.

HANSEN, C. J., and E. R. EGGERS

1936. Propagation of fruit plants. Ext. Cir. 96. 96 p. (Revision in press.)

HENDRICKSON, A. H.

1937. Apricot growing in California. Ext. Cir. 51. 64 p. Revised.

HODGSON, ROBERT W.

1934. The California avocado industry. Ext. Cir. 43. 96 p. Revised.

JACOB, H. E.

1940. Grape growing in California. Ext. Cir. 116. 80 p.

PHILP, GUY L.

1930. Cherry culture in California. Ext. Cir. 46. 44 p.

PHILP, G. L., and G. H. VANSELL

1932. Pollination of deciduous fruits by bees. Ext. Cir. 62. 28 p.

PHILP, G. L., and L. D. DAVIS

1936. Peach and nectarine growing in California. Ext. Cir. 98. 64 p.

SMITH, RALPH

1940. Diseases of fruits and nuts. Ext. Cir. (In press.)

THOMAS, HAROLD E.

1939. The production of strawberries in California. Ext. Cir. 113. 94 p.

THOMAS, H. EARL, and P. A. ARK

1934. Fire blight of pears and related plants. Bul. 586. 44 p.

TUFTS, WARREN P.

1939. Pruning deciduous fruit trees. Ext. Cir. 112. 68 p.

WOOD, MILO N.

1937. Almond culture in California. Ext. Cir. 103. 96 p.

## BOOKS

WICKSON, E. J.

1926. California fruits. 10th revised ed. 502 p. Pacific Rural Press, San Francisco, Calif. Out of print, but available in many libraries. Valuable for early history of varieties.

CHANDLER, W. H.

1928. North American orchards. 516 p. Lea and Febiger, Philadelphia, Penn. Treats briefly of fruits and nuts of America.

POOPENOE, WILSON

1920. A manual of tropical and subtropical fruits. 474 p. The Macmillan Company, New York, N. Y. A treatise of most subtropical fruits, exclusive of citrus.

BAILEY, L. H.

1914-1917. Standard cyclopedia of horticulture. 6 volumes. 3639 p. The Macmillan Company, New York, N. Y. Valuable for propagation and botanical relations of fruits and ornamentals.

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